THE ADVANCEMENT Of the Art of NAVIGATION

In two Parts: Adams 7.65.25

The First, shewing by a new Canon of *Sines*, *Tangents*, and *Secants*, how to resolve all Cases of right-lined Triangles, onely by looking into the Tables, without any Calculation.

Particularly applied to all the three kinds of Sailing:

Viz. { By the Plain Chart, By *Mercators* Chart, By a great Circle,

And to the Art of *SURVETING*.

The Second Part,

Shewing several Observations, for the better ordering of the Log-line, and for the more exact and ready measuring, not onely of Minutes, but Seconds of time, with some new Experiments and Engines for the more constant finding of a Ships way.

By HENRY PHILIPPES.

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AN APOLOGETICAL PREFACE, FOR THE ADVANCEMENT OF THE Art of Navigation.

To all truly Noble minded Engliſh-men, *who are any way concerned in Sea-mens affairs, either as Governours, Merchants, or Mariners.*

BRITAIN is aknowledged to be the *Queen* and *Lady Regent* of the *Seas*, and well may be ſo, both in reſpect of the *number* and *force* of her *Ships*, and the *skill* and *valour* of her *Mariners*. And long I wiſh they may *maintain* their *Credit*, and *improve* their *Art*: But yet let me tell you, that there is of late a *great neglect* of thoſe *means* which have been formerly

formerly used for the *advancement* of this *Art*. Yea, and those *publique Lectures* formerly *appointed* for this *purpose*, were not *sufficient* to *accomplish* it. For what *knowledge* can be *gained* in *this* or any *other Art*, by the *hearing* a *Lecture* there of *now and then*, wherein onely some *one point* of the *Art* is treated of; though it be never so *well demonstrated*, if the *hearer* cannot have *time* or *opportunity* to hear out the *whole*, or *liberty* to *ask* such *questions*, as may be *most useful* for his *present purpose*, or *most tending* to his *instruction* in those things he doth not fully know.

This therefore which I shall propose to your *consideration*, shall be a much more *Royal*, and a far more *sure* and *certain* way for the *advancement* and *perfection* of this *excellent Art*: which is briefly thus:

That there be a *Colledge erected* or *established* in or about the City of *London*, to be *ordered* after the *manner* of the *Colledges* in the *Universities*, (only all the *Lectures* & *Exercises* to be performed in our own *native language*) and the *chief Study* and *endeavour* of the *Governours* of this *Colledge* should be, to *promote* the *Arts and Sciences Mathematical* viz *Arithmetick*, *Geometry* and *Astronomy*, in such a way as they may tend most to the *advancement* of the *Theory* and *Practice* of the *Art of Navigation*, which makes the *most general and profitable* use of *all* these *three*, and of all other *Mechanical Arts* grounded thereupon.

This I confesse is somewhat a great *enterprize*, that I aim at; but for your better *encouragement* hereunto take these *considerations*:

First, that this *way proposed* hath always been *best accounted* of, and always *found* to have the *best successe* for the *advancement* of all *kinds of Learning*, whether *Divine*, *Civil*, or *Prophane*, witnesse the *Antiquity* and *flourishing* of *Universities* and their *Colledges*, not *only* with *us*, but throughout the *whole Christian*, and *Civilized World*.

Secondly, *consider* that this *Art of Navigation* is of such *necessary* and *publique concernment*, that it well *deserves* this *care* and *charges* to be *bestowed* upon it. For (setting *Divinity* aside, which of all *Arts* must have the *preheminence*) I think I may (without

pre-

presumption) *affirm* that this *Art of Navigation* is as (*necessary*, if not *more*) *necessary*, for the *well-being* and *honour* of our *Nation*, then any other *Art* or *Science*, much more *carefully harboured* in the *Universities*. As for instance, if you look upon *Grammar*, *Rhetorick*, and *Logick*, these are but *Introductions* into *other Arts*, *Musick* is of little esteem or use: *Physick* and *Law* are the two *chief Professions* in the *Universities*, but (yet *without envy* be it spoken) I think we might *as well live* without *Physicians*, as the *ancient Romans*; or without *Lawyers*, as *honest and quiet neighbours* might and should, *better* then without *skilful Sea-men*, which are the *chief importers* of our *Wealth*, and *supporters* of our *Warfare*.

Thirdly, *consider* that this *art of Navigation* makes the *most general* and *profitable use* of all the *Mathematical Arts* and *Sciences* professed in the *Universities*. For what *use* can the *Scholar* make of his *Geometry*, with all the *nice* and *notional Problemes* thereof: or what *use* can he make of his *Astronomy*, with all his *curious speculations* about the *motions* of the *Planets*, unlesse they be *applied* to some more *Mechanical* and *Practical Art*; as *Cosmography*, *Geography*, *Surveying*, *Dialling*, *Gauging*, *Architecture*, *Military imployments*, or *such like*. But this *Art of Navigation comprehends* and *makes use* of *all* these: And he that will be a *compleat Sea-man* had need to have *some skill* both in the *Theory* and *practice* of *all* or *most* of these *Arts*. So that no Art is more *capacious*, and were the *excellency* thereof well understood, and put in *practice* as it might be, no *imployment* would be more *honourable* and *advantageous* for the most *generous Gentleman* and *learned Student*, then this of *Navigation*. Thus it was *esteemed* in the dayes of our famous *Queen Elizabeth*.

When *Drake* and *Candish* sail'd the *World* about,
And many *Hero's* found new *Countreys* out;
To *Britains glory*, and their *lasting fame*:
Were we *like* minded, we might do the *same*.

But perhaps you may think that this *Art of Navigation* is *already* brought to that *perfection*, that there *needs* none of this *cost* and *trouble* about it. To this I answer: That the *like* may be

jected against all other *Arts*, which either are or might have been perfected (as some may think) long before this, having been so long and carefully fostered in the *Universities*. But he that is a true lover of Art shall finde that Art is endlesse, and he that hath most skill therein, shall better see his own imperfection. Besides, suppose some men have attained to perfection, yet unlesse there be a constant supply of younger *Students*, in a little time they must die, yea upon a sudden they may be taken away by sicknesse, or some other accident, and their *Arts* perish with them. Thus it happened by *Archimedes*, and many other famous *Artists*, some of whose *Works* we have onely by report and tradition; others, though we may see and admire their famous *Master-pieces*, yet we know not how to perform the like.

But yet let me tell you, for all the great number of Sea-men which we have (which I dare say are as able and skilful as any in the World) yet this *Art of Navigation* wants much of its desired perfection, and which it might arrive unto, if such a Colledge and Society would effectually prosecute and indeavour after it, in this or some such way, as I shall here prescribe unto you.

The first thing I would prescribe to be done by them, is to set forth a good form and method of the whole *Art of Navigation*, according to the best way of practice that is already known and used. This is a thing that hath been alwayes yet much wanting; the old Sea-books being very defective and erroneous, and yet for them (which was a shame to our own Artists) we were beholding to the *Spaniard* and other strangers, they being onely translations of their Works. And though Mr. *Wright*, Mr *Gunter*, and Mr. *Norwood* have done very well in those parts thereof, which they have undertaken, yet they have not gone through with the whole Art, neither have they made those things they write about so plain and practical as they might be, as you may see by this which I have published after them, both in this Book, and in my *Geometrical Sea-man*. And much more I have provided concerning the knowledge and practice of *Astronomy* in the *Art of Navigation*, all which I shall be as free to communicate,

as

as I finde you ready to accept thereof; if this more publique and better contrived method, do not take effect, and ſave me the labour.

A ſecond thing this *Colledge* ſhould indeavour, ſhould be the education of young Sea-men, according to the foreſaid method eſtabliſhed by them: Who ſhould for this purpoſe be inſtructed in all the Arts and Sciences *Mathematical*, by all means and wayes thought fit and neceſſary thereunto; and according to their ſtanding and proficiency herein, ſhould receive ſeveral degrees and titles of dignity and approbation, as it is uſual in the *Vniverſities* for Students in other Arts, which would much incourage them in their Studies, and be a means of their preferment, according to deſert. Some of theſe young Sea-men might be maintained upon the publique Stock; others at their own charges, according as the Revenues of the Colledge ſhall be ſetled or increaſe. And this will be an excellent way for all well-minded perſons to expreſs their charity, eſpecially for ſuch, who being either Sea-men or Merchants, and have gained great Eſtates by theſe Arts, to expreſs their love and thankfulneſs, by relieving and educating the Orphans and children of Sea-men, or others, who by this means may in a ſhort time become skilful Sea-men for the ſervice of their Countrey, and in time may alſo prove worthy Benefactours to this place of their education. Neither need theſe young Sea-men alwayes lie cloſe at their ſtudy, but goe forth now and then upon the publique or private affairs, and ſo learn the Theory and Practice of the Art both together, making this their home or place of retreat in times of vacancy, and want of imployment.

But the third and chief thing that the principal members of this Colledge ſhould ſpend their time and ſtudy in, ſhould be in receiving all *Obſervations* and *Diſcoveries* that have been, or ſhall be made by any Sea-man in foreign parts, and improving them the beſt they can to the publique benefit and advancement of this Art.

And here let me give you a ſhort account of ſome few things the obſervation and regulation whereof after this manner, would

be an admirable advancement to this Art, and without which the Art of Navigation never can or will be perfected.

First, it will be a thing of great concernment to make observation and discovery of the true form and prospect of all the Sea-coasts of any place, Countrey, or Island, with all their Creeks, Harbours, Rivers, and other Entries; and also of all Sands and Rocks, and other dangerous places, especially of such as are not yet known at all, or not so exactly known and described in the usual Chards and Maps, as they ought to be. Most of the Charts and Maps we have already, we being beholden to the *Hollanders* for them, who put us off with their slightest sale-ware, or what they please, concealing many excellent Discoveries from us, which they keep for their own advantage, whereas by this means we might in a short time have better Charts and Maps of our own, then any they have, our Sea men being as skilful to make those Observations as any of theirs.

Secondly, another thing which will be very needful will be to receive Observations and Discoveries of the Tides and Currents at Sea, and of all other motions of the water ordinary and extraordinary, especially of such as are not so well known, or not so carefully observed and regulated as they ought to be. The true knowledge of this would be of excellent use, as you may see by what I have written in the Chapter of Currants.

Thirdly, whereas the great Master-piece and Mystery of *Navigation* lies in the discovery of the true *Longitude* of places, there are several things, (which being diligently observed by this College at home, and other Sea-men abroad, and their Observations communicated and compared) by which the true Longitude of all places may in a short time be found out and determined. And not onely so, but there is great probability they may be brought to such a method, that by some single Observations either at Sea or Land, you may come to know the Longitude of any place whereso ever you are, within two or three degrees, which will be exact enough for the Sea-mans use, and more truth and certainty will be found out hereby, then any yet hath been concerning the Longitude-places, any thing far distant from us.

This

This though it may ſeem ſtrange unto you at the firſt hearing yet there are ſeveral wayes to perform it, So that though you may doubt of one way of obſervation, yet the other may confirm and aſſure you thereof; So that theſe things well obſerved and practiſed will bring this Art to a greater perfection, then ever yet was hoped for.

As firſt for the knowledge of the Longitude of any place by Land, the way I would preſcribe is this: If all Sea-men, in what part of the world ſoever they are, would but obſerve the true time of the beginning and ending of any Eclipſe of the Sun or Moon (which they may do by their ordinary Inſtruments) and would but communicate their Obſervations to this Colledge at their return home; by this means, in two or 3 years time, we might exactly know the true Longitude of all places throughout the whole world, and ſo have more exact and perfect *Globes* made thereof, then any have yet been, or can be made if ſome ſuch courſe be not taken for the reforming thereof.

Secondly, becauſe Eclipſes of the *Sun* and *Moon* happen but three or four times at moſt in a year, ſo that theſe Obſervations can be made but ſeldome, therefore there may be the like Obſervations made of the Conjunctions, Oppoſitions, and Eclipſes (as I may call them) of the little *Planets* which move round about the Planet *Jupiter*, ſome whereof happen almoſt every day. This little *New World*, I confeſſe is lately diſcovered, and not yet commonly known; neither is it to be diſcerned with common eyes, but by the better ſort of *Teleſcopes*, or *Proſpective Glaſſes*, but theſe Glaſſes being procured, the Obſervation is moſt plain and eaſie, and fitter for this purpoſe in ſome reſpects, then the obſervation of the *Eclipſes* of the *Sun* and *Moon*. Nay, theſe *Conjunctions* and other *Phaſes* of theſe little Planets are ſo frequent, that when their motion is a little better known, and brought into a *Method of Calculation* (as it may and will I doubt not ſhortly) you may by theſe Obſervations finde the Longitude of any place, eſpecially ſuch as are far diſtant, to the quantity of two or three degrees: Theſe little Planets being many times ſenſibly diſcerned, to meet and paſſe by each other in the ſpace of two or three minutes of time.

There is a third thing may be made very good uſe of for this purpoſe, which is ſomewhat more practical at Sea then any of the former; and that is the obſervation of the *Variation of the Compaſſe*. This being a thing already in uſe and obſervation among Sea-men; will be ſo much the more familiar to them. And though ſeveral men have had ſeveral conceits about finding the Longitude by the Variation, which have come to little or nothing; yet if the Obſervations and Experiments of all skilful Sea-men were communicated to this Colledge, ſome good way (without queſtion) might be found out thereby, which would much direct the Sea-man in the knowledge of the true Longitude of any place. This way was began to be put in practice by the *Dutch*, as you may ſee in Mr. *Wrights* Tranſlation of their *Haven-finding Art*. The chief thing (I conceive) that cauſed it to be laid aſide was the alteration of the Variation, which was afterward obſerved. But this ought rather to have cauſed the continuance of theſe Obſervations, and the publiſhing of theſe Variations, together with their alterations. For theſe alterations are not ſo much, nor ſo ſwift, but that thoſe Tables of Variation might ſerve well enough for 4 or 5 years without much errour. And then theſe Tables being continually renued and corrected according to the beſt and lateſt Obſervations, they would be a great help to give a good gueſſe whereabouts you are, when you come to the like Latitude and Variation. And not onely ſo, but by the continuance of theſe Tables, and comparing the new with the old, you might come to ſee how faſt the Variation altereth or changeth in one and the ſame place, in any number of years, and ſo in time to come to know the manner of its motion, and the time of its Revolution, which would make the Experiment perfect, and be of great uſe in this Art of Navigation for the diſcovery of the Longitude.

Fourthly and laſtly, (to name no more) there is a good way of obſerving the Longitude of places, either upon the Sea or land, by the ſwift motion of the *Moon*, if it were ordered as it might be for this purpoſe. This hath been hinted at by Mr. *Wright*, *Mr. Linton*, Dr. *Ridley*, *Longomontanus*, and ſome others,

thers, who have ſomewhat too ſlightly handled the buſineſſe: But with good contrivance the thing is very practical, and may be uſed with ſome certainty. For the *Moon* having a very ſwift daily motion, of about 13 or 14 whole deg. each day, ſhe moves above 2 min. for every degree of longitude upon the compaſſe of the earth. Now the motion of the *Moon* being known ſo exactly already, that at any time by Tables you may calculate the place thereof within 4 or 5 minutes, and it being eaſie to make an Obſervation at Sea, to the quantity of 4 or 5 minutes, and at land to a minute or two; it is very likely and reaſonable, that by comparing the Moons place found out by Obſervation and Calculation together, the longitude of any place you are in may be found within a degree or two, which will be exact enough for the Sea-mans uſe, eſpecial in far diſtant places, where two or three hundred leagues difference in their account, is ſometimes no great matter with them.

By this little you may ſee the great Advancement which this *Colledge* may bring to this moſt excellent Art of Navigation; by theſe and many other wayes, which may be found out, eſpecially if there be a free correſpondency maintained between Artiſts at home in the Colledge, and ſuch as go abroad; and without which this Art is never like to come unto the full heighth, and deſired perfection, which will be a great blame and ſhame to thoſe who are any way concerned or imployed therein. And indeed this hath been the general fault of many, who have been skilful Artiſts, that if they finde out, or obſerve any thing more then ordinary, they either through pride or covetouſneſſe keep it as ſecret to themſelves as they can, thinking to make a private benefit or gain thereby. Yea, ſome (worſe then theſe) for very envy, have burnt or caſt away their writings, that others might not have the benefit thereof. This hath been one of the greateſt hindrances of the advancemeut of all kinds of *Learning* that hath or can be. So that were it not for a few more generous and free-ſpirited men, to whom we are beholding for publiſhing their Obſervations and Experiments, we might have been as ignorant of all Learning as the moſt barbarous Nations in the World.

World. But I hope the manifeſt advancement which will come by this Society, and their free and ingenious Communication of their Obſervations will ſtir up all generous mindes towards the erecting and maintaining of ſuch an honourable and ſure foundation for the advancement of this moſt excellent *Art of Navigation*, Which is and ſhall be the hearty deſire and earneſt indeavour of

Henry Philippes.

To the Reader:

The Ingenious and Free-hearted SEA-MAN.

I *Have made ſomewhat a bold adventure, both upon your* Art *and for your* Art, *but yet I hope to come off well enough in both: For as I doubt not your* pardon *for the one; ſo (I am ſure) it is your concernment to be the chiefeſt* Party *to promote the other. And though I have (perhaps ſomewhat too raſhly) given the On-ſet; yet it was not in confidence of mine own skill or power to effect it; but onely to give you an Alarm, and preſent you with a ſure and certain way for the accompliſhment of (that which I hope you all heartily deſire) the* Advancement *of your Noble* Art of Navigation.

I will not charge your Art *with many* Errours, *they being long ſince corrected by a skilful hand: but yet none that have made any progreſs into this* Art, *but ſhall finde and confeſſe, that it wants much of its deſired* perfection. *For the accompliſhment whereof I am ſure there is no better way then this I have preſcribed, and which by your joynt* Endeavours *might be eaſily effected.*

Amongſt the reſt there are two things which will chiefly conduce to this purpoſe. The One is, to procure a Good Method *of the whole Art of Navigation to be publiſhed and eſtabliſhed. The other is, that you would communicate your Obſervations and Experiments, which would much help thoſe who ſhall undertake the Work, and is the onely means to bring the Art to Perfection.*

For the firſt of theſe I have done ſomewhat already in my Geometrical Seaman, *which hath found better acceptance from you then I expected; and that hath incouraged me here to preſent you with another piece thereof, being ſomewhat of an higher nature then the other. For as that performed things by* Geometry *in a more true and exact way then formerly was known: this performs the ſame things much more exactly by* Numbers, *and yet without the trouble of* Calculation. *For here all your Work is performed by new Tables which I have calculated for this purpoſe, which being as it were a large Quadrat or Traverſe-Table, all your Numbers here are caſt up to your hand, ſo that the work will be as readily performed hereby, as by any little Inſtrument, but far more exactly, and with leſſe danger of miſtaking the Numbers.*

Somewhat of this nature hath been done already by Mr. Norwood, *in his* Seamans Practice: *But whereas he onely makes uſe of the Table of* Sines, *I have here ſhewed you the uſe alſo of the* Tangents *and* Secants, *which are both of great uſe, eſpecially the Secants, theſe being indeed the chief Subject of this Book. And as he ſhews how to keep the account of a Ships way by the Table*

of

of Sines after the manner of the Plain Chart; so by these Secants I shall shew you how to keep your account in any Latitude, according to the True Chart, and that without any Calculation, or without the help of Meridional parts; much better then with them. This as it is a thing of great use and service, so (I think I may say) I am the first that ever thought of this way: and as it was some content and pleasure to me in the inventing thereof, so I hope it will be much more useful and profitable to you in the using thereof.

Besides, I have applied these Tables of Sines, Tangents, and Secants in such a general way, first to the Doctrine of plain Triangles, and then particularly to many other conclusions, that you may almost apply them to any purpose, either in Sailing or Surveying, with much ease and expedition.

The second Part of this Book I intended but as a part or an Appendix to the other, but that it is swelled somewhat too great to go under such a denomination. In this the Subject handled is about the way of finding the true Motion of a Ship, a thing as needful as the former, or any other in the Art of Navigation. How I have acquitted my self herein, Time and Experience will better manifest: For many of these Conclusions are but proposed for your trial and approbation: And yet I doubt not but you will finde them very practical and profitable in your affairs.

Besides these, I have somewhat concerning the use of Astronomy in Navigation almost ready for the Presse, which I hope will somewhat further the Advancement of this Art; and I have some thoughts also to make a collection about the Observation of Eclipses, and of the Variation of the Compasse, and the other things mentioned in the Preface, for the better finding of the Longitude. But it is impossible for any one to perfect them, without he should have a free and general communication of these Observations from the most part of Sea-men, which are best skilful in these things: And the Work will never be done as the excellency of the thing requires, unlesse it be performed by a Colledge, or some such Society as I have prescribed, which I doubt not but some Generous Spirits among you, will take some course to bring to perfection.

In the mean time, or if this Design should not take its desired effect, if any of you are so well minded for the Publique Good, as to communicate any of these kind of Observations, you may please to send them for me in writing to Mr. Hurlock, the Book-seller at Magnus-corner: and by the light I shall receive from them, I shall be inabled by Collection to give the stronger reflection, whereby your selves may receive some profit, and be an happy means of the advancement of this admirable and profitable Art of Navigation, which is and shall be the Joy and Delight of

Your Philo-nauticus

HENRY PHILIPPES.

THE SEA-MANS CANON OF TRIANGLES.

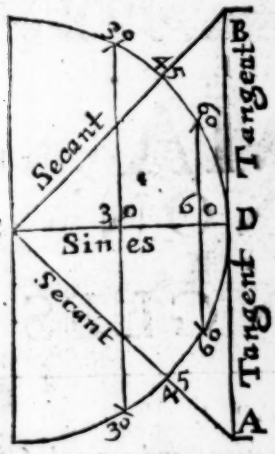
CHAP. I.

Shewing the Demonſtration, and general uſe of theſe Tables.

I Shall not here trouble my ſelfe or you with the definition of thoſe common terms, *viz.* Arches, Lines, Parallels, Perpendiculars, Angles, either right, oblique, obtuſe, or acute; which muſt needs be known to you already, if you have made any entrance into theſe Arts; but yet it will not be amiſſe to demonſtrate unto you what theſe terms Sines, Tangents and Secants

The demonſtration of the nature of Sines, Tangents and Secants.

cants are, and how they ſhew the proportion between a ſtraight line, and the Arch of a Circle, making up alwayes a right lined right angled Triangle: which this figure will demonſtrate to you, better then many words can define and expreſſe.



The Sines you may ſee are the parts of the Radius, or ſemidiameter D C, divided unequally according to their proportion to the degrees or parts of the Arches of the Circle, 30, 60, or the like.

The Tangents are the perpendicular lines either erected or let fall at the end of the Radius, or ſemidiameter of any circle. Thus D B upward, or D A downward, is the Tangent of 45 degrees to the Radius C D.

The Secants are the ſloap lines C B or C A, which joyn the ſaid Radius and Tangents together, making them a Triangle. And this is all the intent of the Tables of Sines, Tangents and Secants, to give the true length of theſe lines to any Arch of a Circle deſired.

The intent of the Tables of Sines, Tangents and Secants.

The defect of the ordinary Tables of Sines, Tangents and Secants.

And this they would performe admirable well, if the Radius or length of the line C D would fall out to be alwayes one and the ſame, equal to the Radius of the Tables, or any number that hath a viſible proportion thereunto, as 100, 1000, 10000, 100000, or the like; for then the Tables without farther trouble, would ſhew you the exact length of your deſired line, according to your Radius and angle given, without any trouble

trouble, but only cutting off a figure, or two, or three from the end there of.

But becauſe this very ſeldome happens, therefore for the moſt part men are forced to find out their deſired numbers, by the proportion which they have to theſe numbers in the Table; making ſometimes one of thoſe lines ſtand for the Radius, and ſometimes another: For any of the three lines may be made to ſtand for the Radius, and the other two lines will be either Sines, Tangents or Secants thereto, and the proportion will alwayes hold, The remedy which though moſt exact; yet is very troubleſome.

As the Radius of your Table, 1000, 10000, or 100000 parts,
To the length of the line which you make the Radius;
So is the Sine Tangent or Secant of any angle in the Tables,
To the length of the line required.

And thus by the Golden Rule of Three, (as ſome call it,) or the Rule of Proportion, ſome of the parts of a Triangle being known, the other may be found out thereby.

But theſe operations as they are unknown to ſome, ſo they are ſometimes troubleſome to thoſe who are beſt skilled in Arithmetick, eſpecially when the Radius of the Tables is larger then it need be; and therefore ſome for their eaſe herein make uſe of the Tables of Artificial numbers or Logarithms, But though the Logarithms are of very good uſe in Spherical Triangles, where both the ſides, and the angles are meaſured by the Arches of a Circle; yet in plain Triangles you may as well, or better performe this, by natural numbers: For while you look out the Logarithme of your ſides (which you need not do, if you worke by natural numbers,) you may as ſoon reſolve your angle, by one Multiplication or Addition, if the Radius of your Tables be not too large, which in moſt of theſe queſtions need not exceed 10000. Theſe Tables are more ſpeedy and eaſie then the Logarithmes, which are troubleſome in theſe plain triangles.

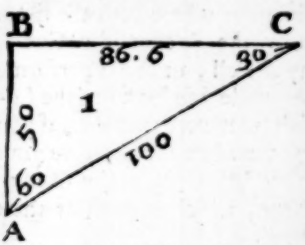
And therefore for the proof and explication of the following way, I have in the end of the Tables, added a brief Table of Sines, Tangents and Secants in Natural numbers

(being somewhat scarce to be had elsewhere,) which Table is calculated to every degree, and tenth Centesme, or sixth minute of the Quadrant, and by the differences added, you may find any angle to a minute or hundred part. By which Table if you please you may sometimes work your questions, by which you shall better see the nature of the work, and examine the true performance thereof when you donbt of any thing.

These are in effect 100 several Tables to an 100 several Radii.

But the way of these my new Tables is much more ready then any of these wayes. For I have calculated these Tables to every whole degree of the Quadrant in such a manner, that they answer to any Radius from one to an hundred expressely and exactly, without any further trouble, but onely opening the book and turning to your angle or side desired. For they are indeed an hundred several Tables all joyned in one book. And though the greatest expressed Radius doth not exceed an 100: yet this number of an 100 is as great a number as you need put for any Radius in most of these questions. And if at any time your Radius needs to be greater, it is but adding two of these numbers together, so you have the like for any number under 1000 or 10000.

For Example, take this proposition which is the most ordinary and usefullest in the practice of Navigation, *viz.* By the Rumb and the Distance, to find the difference of latitude and longitude. Thus let distance sailed be AC 100 miles, and the Rumb or angle at A, North Easterly 60 degrees: and therefore the angle at C is the complement thereof or 30 degrees, & it is desired to find the side A B, which is the difference of latitude, and the side B C, which is the difference of longitude.



To performe this the ordinary Rules are thus,

As

As the Sine of the Angle at B, ſine 90 d. 10000,
To the ſide oppoſed thereto, ſide A C 100.
So the Sine of the angle at C, ſine 30 d. 5000,
To the ſide oppoſed thereto, ſide A B 50.
So the difference of latitude is 50 miles or minutes.
Then for the difference of longitude,
As the ſine of the angle at B, ſine 90 d. 10000,
To the ſide oppoſed thereto, A C 100.
So the ſine of the angle at A, ſine 60 d. 8660,
To the ſide oppoſed thereto, B C 86.6.
So the difference of longitude is 87 miles or minutes *ferè*.

The way of working by the ordinary Tables of Sines Tangents and Secants, which is abreviated and ſet at the end of theſe Tables.

You ſee here the trouble that there is to find theſe ſides, which cannot be avoided though the numbers were leſſe, or though (as I ſaid before) you ſhould work by Logarithmes; Onely in ſuch a caſe as this, the ſide A C which is the Radius being juſt 100, and ſo bearing a plain and viſible proportion to the Radius 10000, being all one with it if you cut off the two laſt cyphers; So likewiſe the other two ſides, have the ſame proportion to their oppoſite ſines, being all one with the ſines thereof in the Table, onely cutting off the two laſt figures; and thus they ſhew the ſides to be 50, and 86.6, or 87 *ferè*, which would much ſhorten the work, if it would often, or alwayes fall out ſo, but this ſeldome happens, and cannot be expected, in the uſe of the ordinary Tables, which are limited and calculated to one onely Radius, of 1000, 10000, or 100000, or the like.

The way of working by theſe new Tables.

But now theſe my new Tables, are calculated to any Radius whatſoever, being expreſſe and exact from 1 to 100, (and may be made to ſerve very well to 1000, or 10000, with a very little more labour, as you ſhall ſee preſently,) ſo that let your Radius be what number ſoever you have occaſion to uſe, you need only find out your angles, or any one of the angles at the top of the leaves, and your number of diſtance in the ſide or margent of the Table, and in that line under the ſaid angles you ſhall find

find there both your ſides together, ready caſt up to your hand, without any further trouble. For in thoſe right angled triangles, the two acute angles being alwayes the complement of each other, the ſides go alwayes both together, as their angles do, which are therefore fitly termed Coſines.

Thus in this Example, if you turne over the Tables till you come to the angles 60 d. or 30 d. which are both together, and look down the ſide or margent for your diſtance run, which was 100 miles; which you ſhall find at the bottome of the right hand page; you ſhall find in that line under the title of ſines, thoſe foreſaid Numbers, 86.60 parts for the one ſide, and 50.00 parts for the other ſide, according to the former calculation.

Mark theſe Rules well for they are of great uſe.

And thus you ſhall alwayes find your numbers ready caſt up to your hand, let your Radius or given ſide be what it will under an 100. For inſtance,

		N. pts.		*N. pts.*
The Radius or	20	The one	17. 32	The other 10. 00
the ſide A C	30	ſide is	25. 98	ſide is 35.00
being	40		34. 64	20. 00

If your Radius be more then 100, yet if it have a Cypher in the laſt place, it is but altering the places of the figure in the Table, ſetting the latter figures a place forwarder, and putting a Cypher at the end thereof. Thus,

		N. pts.		*N. pts.*
The Radius	200	The one	173.20	The other 100.00
being	300	ſide is	259.80	ſide is 150.00
	400		246.40	200.00

Or elſe at the moſt it is but taking your numbers out at twice, and adding them together. Thus if your Radius were 155.

Firſt,

	N. pts.	*N. pts*
First, for 100,	The one side is 86.60	The other side is 50.00
then for 55	47.63	27.50
which added together make	134.13	77.50

This parting of the numbers in the Table in the midst is of great use, for the marginal Radius being but to 100, the first part of the number in each columne, answers exactly to the said Radius expressed in the margent in whole numbers or Integers, and the two figures following, is onely a Decimal fraction, or rather Centesme thereof, for the more exactnesse; because the first number very seldome falls out exactly in whole numbers to any of the said Radii. And therefore I have titled all the columns thus *N. pts.* the *N* shews the whole numbers or Integers of your Summe or Measure, and the two last figures the parts or fraction thereof.

Why the numbers in the Tables are all parted in two parts.

Now though it be the best way to reckon the way of your Ship in Degrees and Centesmes or 100 parts: yet these Tables will serve for any other way of account either by Sea or Land, though you reckon by leagues, Miles, or Minutes, Chains, Poles, Fathams, Feet or Inches, or any other measure whatsoever. Alwayes observing this rule, that look what sort of measure soever, the number which you look in the margent is of, according to that measure in the first part of the number in the columne shews the whole leagues, miles, &c. and the two last figures shews the fraction thereof in 100 parts.

Thus if your marginal number or Radius be	Degrees	Then the 2 parts of the Tabular numbers under the titles of *N.* and *pts.* stands for	Degrees and their 100 parts
	Leagues		Leagues and their 100 parts
	Miles or Minutes		Miles or Minutes and their 100 parts
	Centesmes of a degree		Centesmes of a degree and their 100 parts
	Poles		Poles and their 100 parts
	Fathams		Fathams and their 100 parts
	Feet		Feet and their 100 parts
	Inches		Inches and their 100 parts

Any

Any of these Integers and parts you may use readily without any Reduction; yea though they are fractions of fractions, *viz.* 100 parts of 100 parts, yet they may be added and substracted, as if they were all whole numbers, onely by placing them a place or two forwarder, which is a great ease in the way of calculation.

Thus, for Example, if you reckon your Ships way in Degrees and Centesmes of a Degree; the first part of these numbers will stand for degrees, the latter part for Centesmes; but then for exactnesse you will have many times the 100 parts of these Centesmes fall in, which yet will be without any trouble, either taken in or left out: whereas other fractions require reduction. On the other side if you reckon your ships way in Centesmes, and their 100 parts; in the addition of your Numbers, these Centesmes will make degrees, whose number you will may plainly see without any reduction.

Thus the angle being 30 d. the sine of 545 Centesmes, or 05 d. 45 Centesmes.

	D. C. pts.
05 deg. is	4 33.
45 Centesmes	38. 79
	4. 71. 79

The angle being 60 deg. the sine of 5045 Centesmes, or 50 d. 45 Centesmes.

	D. C. pts.
5 0 deg.	25.00.
45 Centesmes	22. 50
	25. 22. 50

How to make the Tables serve to any Radius under 10000.

By this you may see the Tables will serve to any number almost you please, but with exactnesse to any number under 10000; for if you part your given Number or Radius in two parts, taking still two and two figures together, the Tables will give you the Sine, Tangent or Secant of that Radius.

Thus

Thus the Radius being 9999, and the angle 30 deg.

The sine of 30 d.			The Tangent of 30d.			The Secant of 30 d.		
For 99.00	85	74	99.00	57	16	99.00	114.	31.
For 00.50		85 74	00.99		57 16	00.99	1. 14.	31
	86	59 74		57	73 16		115. 45.	31

Which numbers you may close in the Addition, and cast away the two last figures, as a fraction of small value, especially if it be lesse then 50; and if it be more then 50, you may adde one to your Number for it, thus these numbers will be 8660 *ferè* 5773 (16 11545 (31.

But here will be all the difficulty, that these numbers sometimes having two figures in both parts, and sometimes three in the first, you must be carefull how to part and place them, as you may see by the last fore-named Secant. The best rule I can give you is this, that alwayes when your number hath 4 figures and so you take them 2 and 2, the number of the two latter figures, must be set so, that the two last figures thereof must stand quite beyond all the other figures of the first number. and the rest of the figures must be placed in their order under the first number, and thus doing: it is no matter whether you keep them apart, as they are set down in the Tables, or set them close together, as here, and as I said before, you may cut of those two last figures, from your total summe as a fraction, or adde one Integer to the fore-part of the number when it is above 50, and so it shall be agreeable to your Radius.

Note this well for you must have care in placing the numbers.

Thus the Radius being 9999 and the angle 60 d.

The Sine		The Tangent		The Secant	
99.00	4950	99.00	17146	99.00	19800
00.99	4950	00.99	17146	00.99	19800
	4999.50		17317.46		19998.00

To make the tables serve to a Radius of 100000.

If you have occasion to use a Radius that hath five or six places, you may take it out at thrice, observing the same rules, and setting the last number, one figure forwarder for five figures, and two figures forwarder for six.

Thus the Radius being 99995, the angle 60 d.

	The Sine	The Tangent	The Secant
For 99.00.0	4950	17146	19800
For 00.99.0	4950	17145	19800
For 00.00.5	0450	0866	1800
	49999.50	173183.26	199998.00

A good short Ruler to save much trouble.

Or in these large numbers, though your Radius have 5 or 6 figures, yet you may take out your number at twice for the four first figures, and either neglect the last figure or figures, or if they be above 5 or 50, add a unite to the two former figures for them.

And thus you see that though the marginal Radius of the Tables runne but to 100, yet they may very well serve to any Radius under 10000, or 100000, which will be as great (or greater) then you need to use at any time.

But yet there is one point these Tables may seem defective in, and that is, because they are cast up onely to whole degrees of the Quadrant; So that if you have occasion to find these things, for the halves, or quarters, or minutes, or Centesmes, or any other parts of degrees, you are then somewhat to seek. And this may seem the more considerable, because the angles of the Rumbes seldom happen to be just whole degrees.

An Apology shewing the reason, why the Tables are cast up only to even degrees; and not to Rumbes and quarters.

Though this may seem somewhat considerable in conceipt, yet in effect and practice it will come to nothing. For a degree is so small a part upon the Sea-mans Compasse, that it is impossible to steer a ship so directly, that it shall keep to the true point you reckon upon so exactly, but that you may misse a degree or two (if not more) if you be not the more carefull therein. And therefore it will

will be exact enough for your account, if you reckon upon just and even degrees, taking that degree which is neerest either under or over, and if there be any odd minutes or parts of a degree in your angles, you need regard them no farther.

But whereas the Rumbes and their halves and quarters seldome happen to be just even degrees, and therefore it might be thought more convenient to have calculated these Tables to these Rumbes and their parts. To this I answer: that though it be good alwayes to steer upon some Rumbe of your Compasse or other, because they are most visible thereon, yet by reason of the variation of the Compasse, (which you must alwayes allow for in your account) you will have very seldome occasion to keep your account according to the angles of the Rumbe, but 3, 4, 5, and sometimes 10 or 12 degrees to the Eastward or Westward thereof, according as the variation of the Compasse in that place requireth. And upon these considerations it would be much more trouble, or far lesse exact to allow for the said variation in such Rumbe Tables; then in these which are cast up to every degree: each quarter part of a Rumb being almost three degrees.

Yet the Rumbs and quarters are set down on the sides of the Table, to those degrees to which they best agree; and the true quantity of their angles and degrees and minutes, according to the usually way, of which you may make use if you please.

Your best way therefore of keeping your account in this respect; is first to consider the Rumb upon which you sail according to the directions of your Compasse: then to consider the variation of the Compasse, and so to find the true degree of your course from the Meridian, reckoning it to be Northeast or Southeast: Northwest or Southwest so many degrees, taking still that degree which is neerest either under or over, and neglecting the odd minutes or parts; and if you be careful herein that there be no other error then these odd minutes will make, your account (I dare warrant you) will be exact enough.

How to reckon the deg. of your course.

But yet, I confesse, it would be much better in some cases, where the angles are more exactly known, if these Tables were calculated to some intermediate parts. But this would make them increase to so great a volume, that few would

goe to the price, For if they ſhould be calculated but to every ſixth minute, or tenth part of a degree, this would make them ten times more then they are, which would take up 120 ſheets of paper in this figure. But yet becauſe I would make theſe Tables as exact and uſefull as I could, I have bethought my ſelfe of a way which ſhall almoſt as well performe this, without any ſuch increaſing of the Tables; and this is by ſetting down the differences between each degree, for every fifth Number or Radius, which differences are ſo ſet in the parting of the columns that they take up little or no roome, and if you carefully proportion them thereby, you may performe this buſineſſe very exactly: but if you be not carefull, you may make your errour worſe by your curioſity, and therefore for your better direction herein, take theſe inſtructions.

1 Theſe tranſverſed figures ſhew the difference between each degree.

Firſt, that theſe figures, thus placed, ſometimes upward and ſometimes downward, expreſſe the difference which is between the degrees wherein they are placed and the degree in the leafe following or preceeding, and not between line and line: For that is needleſſe to ſhew, being better found by the alteration of the Radius, for if you obſerve the firſt line of each degree, that ſhews the difference between line and line, the Table being made by a continual addition of that firſt number.

2 Theſe differences belong properly to the middle number of the ſpace.

Secondly, that this difference here ſet down, belongs properly to the middle number of that ſpace wherein it is placed; but yet will ſerve well enough for any of the other in the ſaid ſpace, if the difference between that and the next ſpace be not too great, and then if you will beſtow the paines you may proportion it.

3 The differences are parted into Numbers and parts, as the columns are.

Thirdly, theſe differences are parted into two parts by a (.) or point, upon the ſame account which the numbers in the columns are parted; ſo that the firſt figures or part before the point ſtands for whole numbers, in reſpect of the Radius; and the other figures after the point, ſtands for the hundred parts thereof.

4. Fourthly, theſe differences for the moſt part reſpect the

fol-

following degree, according to the ſucceſſion of the number of the degrees in the Table; and therefore they are placed ſometimes looking downward, and ſometimes lookng upward, according as the degrees are forwarder or backwarder in the book. For as the one halfe of the degrees, from one to 45 goe forward, ſo theſe differences therein look downward, and reſpect the following degree, both according to their number and place in the Book. But then at 45 the degrees of the Table turn back again, and ſo run backward to 90 degrees, and therefore in theſe the differences are placed to look upward, or as it were backward in reſpect of the Book, but yet are forward according to the order of the degrees in the Tables.

These differences moſt properly reſpect that degree toward which they look.

Fifthly, look which way thoſe differences look, they are moſt properly to be added to the parts or minutes of the next degree that way; ſo that if they look downward, they muſt be added to the degree in the following leafe; if they look upward, they muſt be added to the degree in the foregoing leafe of the Book: but yet you may ſubſtract them (without much errour) from the degree from which they look.

5 These differences muſt be added to the degree toward which they look; and ſubſtracted the other way.

Sixthly, in the two columns of Sines they are placed ſomewhat otherwiſe, then they are in the Tangents and Secants, (ſo that they are to be ſubſtracted, as the degrees increaſe;) yet the former rule concerning them, holds good in theſe alſo, that they muſt be added or ſubſtracted to or from that degree toward which they look; ſo that if they look downward, they muſt be added to the degree in the following leafe; and if they look upward, they muſt be added to the degree in the fore-going leafe, though it be contrary to the order of the number of the degrees.

6 The difference in the Sines muſt be added contrary to the order of the degrees in the Table.

Seventhly, as this difference muſt be added to the degrees wherein they are, when they look forward or downward; ſo they muſt be ſubſtracted from the degrees in which they are, when they look upward or backward. And this Subſtraction though it ſeldome or never is uſed in the Tangents or Secants; yet in the Sines both muſt be conſtantly uſed; and you muſt ordinarily firſt begin with Subſtraction.

7 The difference in the Sines is ſo proportioned that it may be added or ſubſtracted according to their aſpect without any error.

ſtraction. For theſe two columns being the Sine and Coſine of your Radius, if the one be ſhorter, the other muſt needs be longer, the Radius being the ſame. Therefore your firſt ſide, or that which lies under your angle, being alwayes the ſide of latitude, if that be to be ſubſtracted from; then on the contrary; the other ſide being the ſide of longitude, muſt have a proportional addition according to the difference thereof, that ſo the three ſides may make up a perfect right angled Triangle.

This is the hardeſt part of this work for the proportioning of theſe Tables, and yet the moſt uſefull, and therefore I ſhall make this, and moſt of the reſt plain by this Example.

	Sines			
	30		60	
	N.	pts.	N.	pts.
51	44	17	25	50
52	45	03	26	00
53	45	90	26	50
54	46	76	27	00
55	47	63	27	50

	Sines			
	21		59	
	N.	pts.	N.	pts.
51	43	71	26	27
52	44	57	26	78
53	45	44	27	30
54	46	29	27	81
55	47	14	28	33

Let

Let your angle at A be 30 deg. and an halfe, and the Number of your Radius or ſide A C 53, and it is required to find the ſides A B and B C.

Firſt, theſe Tables ſhew you (as you may ſee by this peece thereof) that if your angle were juſt 30 degrees, the number of your Radius or ſide being 53, the longeſt ſide ſhould be 45.90 parts, and the ſhorteſt ſide, 26.50 parts.

But in the ſecond place becauſe your angle is not juſt 30 deg. but 30 deg. and an halfe, if you will proportiou theſe ſides, according to the difference between this degree and the next, which is 31 deg. you ſee the difference for this ſpace of the Table at 53, in the one column is 0.46, which muſt be ſubſtracted, becauſe it looks upward from the following degree. Now the half of this being 0.23 parts, being ſubſtracted from 45.90 parts, there remaines 45.67 parts for the ſaid ſide corrected.

45. 90	
Sub. 23	
45. 67	

On the contrary, the difference of the Coſine in the other column being 0.80 parts, which looketh downward, muſt be added to the other ſide, the halfe therefore of this difference being 40, muſt be added to the other ſide which is 26.50 parts, which makes it 26.90 parts. And thus you have exactly the two ſides belonging to this Radius 53, and the angles 30 d. $\frac{1}{2}$, and 59 d. $\frac{1}{2}$, *viz.* 45.67 parts, and 26.90 parts, as you may ſee plainly if you compare it with the following leafe.

26. 50	
ad. 40	
26. 90	

And as here you ſee the way of worke for an half degree, ſo you may do the like for a third, or a quarter, or a tenth, or any other part of a degree, proportioning the difference in the Table accordingly: and if you will be ſo curious, by the Table of Proportion (following all the reſt of the Tables) you may almoſt proportion it to a minute, but very readily to 3 minutes, or $\frac{1}{20}$ parts of a degree. And thus thoſe differences being fitly applyed, will make the Tables as exact and uſefull, as if they were calculated to every tenth part of a degree, and ſo increaſed ten times more in bulke.

Laſt

Note this well for it will much help in all the rest.

Last of all, if the proportioning of these differences seem too troublesome, in most questions of Navigation you may wholly neglect them; Or at the most all I would wish you to do is thus, that when the differences come to be great, so that they may alter your number, an Integer, or two, then you may take notice of these differences and proportion them according to the former rule: Wherein also the Tables themselves, will direct you when to adde, and when to substract; if you turne but over the leafe, and see whether the next degree be more or lesse, in the correspondent place thereto, And this is the surest rule of all.

CHAP. II.

Shewing the general use of these Tables, in the resolution of all right lined Triangles.

BEfore I come to the calculation of these Triangles, give me leave to shew you some general observations, for your better understanding, and proceeding therein.

1 A Triangle is a figure constituted by the conjunction, connexion, or intersection of the three sides or lines thereof, in the three angles or meeting places thereof, So that every Triangle hath six distinct parts; *viz.* the three sides, and the three angles.

2 The angles of a Triangle are measured by the Arches of a Circle; which is ordinarily divided into four Quadrants; each Quadrant having 90 degrees, and each degree 60 minutes, or 100 Centesmes, and according to the quantity of these arches, they are called either Right angled or Oblique angled Triangles.

3 A Right angled Triangle, is that which hath one angle thereof (and it can have but one angle neither) equal to the Quadrant of a Circle or just 90 degrees: All others are oblique angled Triangles.

4 Ob-

4 Oblique Triangles are either acute or obtuſe. If they have all their angles leſſe then Quadrants, then they are acute angles; if they have one (and they can have but one) angle greater then a Quadrant, then they are called obtuſe angled Triangles,

4 The three angles of any right Triangle are equal to two Quadrants, or halfe a Circle, being 180 degrees: So that any two of the angles being known, the third angle is the complement thereof to 180 degrees.

5 This is ſomewhat more readily found in a right angled Triangle; for there the right angle being a quadrant or 90 degrees, any one of the acute angles being known; the other is the complement thereof to 90 degrees; Now theſe and all moderne Tables of Sines, Tangents and Secants are ſo framed that they proceed forward only to 45 degrees, being halfe the quadrant; and then they turn back again till you come to 90 degrees, by which meanes you have the acute angle; and the complement thereof to 90 degrees alwayes joyned together, without any farther trouble, which are therefore fitly by Mr. *Gunter* and others, called Coſines, and Cotangents.

6 If any angle be greater then 90 degrees, (and ſo not to be found in the Tables,) take the complement thereof to 180 degrees, and work by that, and your work will be all one. Or elſe (as theſe Tables are framed) you may uſe the Coſine, or Cotangent of the exceſſe above 90 deg. which is all one with the complement of 180 degrees.

7 The ſides of any plain Triangle may be meaſured by any meaſure or Scale of equal parts, as Inches, Feet, Yards, Poles, Miles, Leagues.

8 Any three parts of a Triangle being known, the other three may be known thereby; unleſſe it be the three angles onely of a right lined Triangle, and then the proportion of the ſides may be found though not their length. Now this finding of ſome parts of a Triangle by the other is very neceſſary, For ſometimes you may come to meaſure the ſides of a Triangle, and have no Inſtruments to take

the angles: at other times you may obſerve the angles, and cannot come to meaſure the ſides; Now herein ſome kind of calculation is very neceſſary; and from hence ariſeth the ſeveral caſes of a Triangle, as ſometimes two ſides are known, and but one angle; ſometimes two angles are given and but one ſide, &c.

In moſt of which caſes, this is a general rule, that the ſides and angles, have a mutual proportion each to the other; ſo that they are known by their oppoſition one to another; which obſerved, will reſolve moſt caſes in Triangles. For this is true in all Triangles.

As the Sine of any Angle,
To the parts of the ſide oppoſed thereunto:
So is the ſine of any other Angle,
To the parts of the ſide oppoſed thereunto.
Or,
As the parts of the ſide of any Triangle,
To the Sine of the Angle oppoſed thereto:
So the parts of any other ſide of that Triangle,
To the Sine of the Angle oppoſed thereunto.

9 There is ſome difference among Authours in the denomination of the three lines of a right angled Triangle. Some call the ſloap ſide the Baſe; and the other two lines the greater, and the leſſer ſide. Others call the lower of the two ſides, the Baſe; the other of them, the Perpendicular; and the ſloap ſide Hypothenuſal. It is no great matter which way you call them, ſo you underſtand which you meane; But in the Art of Navigation, it will not be unfit to call one of theſe ſides the Parallel ſide, or ſide of longitude; the other the Perpendicular ſide, or ſide of latitude; and the Hypothenuſal the ſide of Diſtance.

Theſe things premiſed, I ſhall briefly run over the ſeveral Caſes of right lined Triangles, joyning two Caſes together, becauſe theſe Tables will performe two or three things

things very well together. And I shall shew you how to do this two wayes, first by the ordinary Tables of Sines, Tangents and Secants, which is abbreviated, and joyned to these new Tables: or if you please, you may work them by the Tables of Logarithms; either of which, the rules will agree to; And then I shall shew you how to perform them by my new Tables; whereby you may the better see not onely their ease and readinesse, but their sufficiency and exactnesse.

1 Case.

The angles and Hypothenusal given
To find both the other sides;
The side A C is 82, the angles at A and C 30 d. and 60 d.

To find this by calculation, the rule is thus.

As the Radius or whole sine,
To the Hypothenusal;
So the sine of either of the angles,
To the side opposed to the said angle.

The work by calculation.

Thus as R 10000, to AC 82 : : so sine 30 d. 5000, to BC 41.
And as R 10000, to A C 82 : : so sine 60 d. 8660, to AB 71.

To performe this by these Tables.

Turne to either of the oblique angles, either 30 d. or 60 d. (for you shall find them both together, the one being the complement of the other,) and look down the margent of that leafe, till you find the number of your Hypothenusal A C 82, and in that line under the said sines you shall find 71.01 parts, for the one side, and 41.00 parts for the other side.

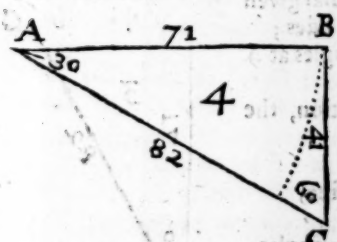
The work by these Tables.

Here, take notice that in these Tables, the greater side

Caution.

falls under the leſſer angle, and the leſſer ſide under the greater angle, 71.01 parts, being under the angle of 30 d. and 41.00 parts, under the angle of 60 deg. which ſhould not be, for the greater angle doth alwayes require the greater ſide. But this is no fault in the Tables, they being thus tranſpoſed on purpoſe upon good reaſon, as you ſhall ſee hereafter, and it is to be underſtood alwayes that the greater angle requires the greater ſide.

The 2 and 3 Caſes.



2 *Caſe* By the angles, and one of the ſides; to find the other ſide.

3 *Caſe* By the angles, and one of the ſides; to find the Hypothenuſal.

This might be performed by the oppoſition of the ſides to the angles, as before. But it is better to performe it by the Tangents and Secants. Thus the ſide given A B 71, being made the Radius; the ſide B C, will be the Tangent thereof; and the Hypothenuſal A C will be the Secant thereof.

By calculation.

So that as the Radius 10000,
To the ſide of A B 71
So the Tangent of 30 d. 5774
To the ſide B C 40.995

And ſo likewiſe is the Secant of 30 deg. 17321,
To the Hypothenuſal A C 81.9837.

By theſe Tables.

To performe this by the Tables, Find out your Center angle at A which is 30 deg. in your Tables, and look down

down the margent of the leafe, till you come to the number of your side A B which is 71; and in that line for the Tangent of 30 deg. you shall find 40.99 parts, and also in the same line for the Secant of 30 d. you shall have 81.98 parts, which is the just length of the two sides being 41, and 82 very neer, according to the figure.

The like you should find if the side C B were the Radius; For finding this side C B 41 in the margent, the Tangent of the angle at 60 d. will be found to be 71.01 parts, and the Secant of the said angle of 60 d. is just 82.00 parts, which in effect is the same with the other.

The 4 and 5 Cases.

The 4 *Case.* By the two sides, to find either of the angles.

The 5 *Case.* By the two sides to find the Hypothenusal. In the former figure,

Making the side A B the Radius.

By calculation.

As the one side A B	71	
To the other side B C	41	
So the Radius	10000	
To the Tangent of the angle C	30.5775	

Multiply 41, by 10000, it makes 410000, which is the Tangent of 30 d. *fere.*

Thus you have the angle at A. But for the side A C you must work again by the 3 Case, and find it by the Secant. Or else you may find it by adding the squares of the two sides together, and substract the root thereof, and it is the Hypothenusal.

The Square of 71 is	5041
The Square of 41 is	1680
Which together makes	6722

Which

Which is the Square of 82, or very neer; the true Square being 7624.

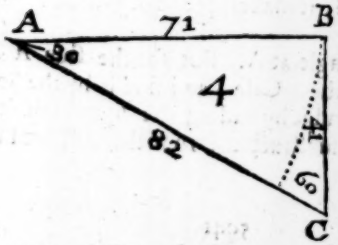
To performe this by theſe Tables.

But this is far more readily performed by theſe Tables, as thus, you muſt conceive the ſide A B, being the Radius, the ſide B C is the Tangent, and the ſide A C is the Secant of the center angle at A. Therefore turn over the leaves of the Table, ſtill obſerving the Radius which is 71 in the margent, till you find the other number which is 41, under ſome one of the Tangents, which you ſhall find under the Tangent of 30 deg. where againſt 41 in the margent, you ſhall have 40.99 parts for the Tangent, therefore the angle is very neer 30 degrees.

And thus having found the angle of the Tangent ſide to be 30 deg. look in the ſame line for the Secant of this angle, and you ſhall find 81.98, or 82 *fere*, for the Hypothenuſal A C. Thus neglecting theſe ſmaller fractions, you may conclude the angle is 30 deg. and the Hypothenuſal 82.

The ſame you ſhall find if you made the ſide B C 41 the Radius, for againſt 41 under the angle 60 you ſhall find the Tangent to be 71.01 parts, or 71 very neerly, and the Secant thereof is 82.00 very exactly.

The 6 and 7 Caſes.



6 Caſe. One of the ſides, and the Hypothenuſal given, to find the angles.

7 Caſe. One of the ſides, and the Hypothenuſal, to find the other ſide.

This by calculation muſt be performed at two operations as before, firſt, to find the angle at the Center A, then to find the ſide CB oppoſed thereto, as thus,

As

As the ſide A B	71	By calculation.
To the ſide A C	82	
So the Radius	10000	
To the Secant of the angle 30 d.	11549	

Mulkiply 82 by 10000 it is 820000, which divide by 71, the quotient is 11549 the Secant of 30 d. *fere.*

Then the ſide B C is the Tangent of this angle as in the 3 Caſe.

Or elſe ſubſtract the ſquare of the ſide known, from the ſquare of the Hypothenuſal, and there remaines the ſquare of the other ſide.

The ſquare of the Hypothenuſal 82 is	6724
The ſquare of the ſide A B 71 is	5041
Which ſubſtracted, there reſts	1683

Which is the ſquare of 41, the third ſide or very neer the true ſquare, being 1681, this differrnce is in the angle not in the rule of ſquares.

To performe this by theſe Tables the work is onely thus, you muſt make the ſide known A B 71 your Radius, and the ſide A C 82 the Secant thereof: Look over the Tables therefore, till you find 82 in the Table of Secants, againſt 71 in the margent of any leafe, and this you ſhall find under the angle of 30, where againſt 71 in the margent, you ſhall find 81.98 parts for the Secant of that Radius. This is therefore the true angle thereof. By theſe Tables.

Then for the ſide B C it is onely the tangent of this angle; which you ſhall find in the ſame line, under the tangent of 30 to be 40.99 or 41.

The ſame you ſhall find if you made the ſide B C Radius, for the Secant of 41 is 82.00 parts, under the angle of 60 degrees. And the tangent thereof is 71.01 parts, or 71 very neer.

The

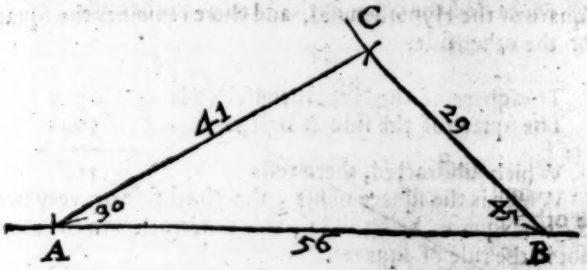
The 8 Case.

Of Oblique Triangles.

The Angles being known, and one of the sides to find the other two sides.

In the triangle A B C, the angle at A is 30, the angle at B is 45 d. the side B C is 29.

This Rule is true in all triangles, whether Right or Oblique.



As the Sine of any angle A 30 deg. 5000
To the side opposed thereunto; C B 29
So is the Sine of any other angle, as B 45 deg. 7071
To the side opposed thereto. A C 41.

To performe this by these Tables, Turne to the angle given, which is 30 d. and there you * should look down that column of Sines, till you meet with your given side, which is 29: but because these two columns of Sines are transposed, look down the column under 60 till you meet with your side 29, and mark well in what line it stands, which is against 58 in the margent. Then turne to the other angle, which is 45 d. and in that very line of the tables against 58 in the margent you shall have 41.01 parts, for the other side A C which is required.

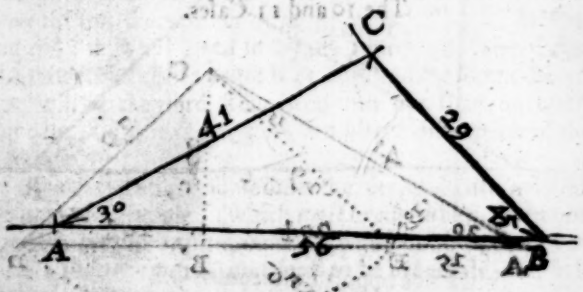
* The Sines in these Tables being inverted shew the complements of the angles, in respect of their titles, so that you must be carefull in which column you seek your first side, and there is no great danger of erring in the other, because the Triangle will shew which of the two sines is most likely to be taken.

And

And so if you would know the side A B opposed to the angle C, which is 105 deg. you must do the like, onely because this angle exceeds 90 deg. you must take the complement thereof to 180, or the Cosine of the excess above 90 deg. either of which is 75 deg. and under this angle, you shall find against 58 in the margent 56.63 parts or 56 for the side A B.

The 9 Case.

Two sides with an angle opposed to one of them being given; to find the other angles, and the other side.



This rule is also true in all triangles, being but the converse of the former; for the sides and the angles have a mutual proportion one to the other. So that

By calculation

As the side opposed to the angle given 29
Is to the sine of the said angle 30 deg. 5000
So the side opposed to the angle required 41
To the sine of the said angle 45d.7071

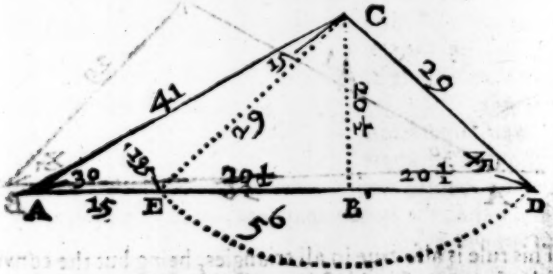
Turne to the sine of the angle given, which is 30, (but you must take the complement thereof, which is 60 because the tables are transposed) and there look down that column, until you find your given side 29, which you

To performe this by the Tables.

may observe to stand just against 58 in the margent. Mark this marginal number well and turn over the tables leafe by leafe, till you find your other given side, which is 41, just in the like line against 58 in the margent, and this you shall find under the line of 45 deg. where the number against 58 is 41, 01 which being so neer, you may conclude it to be the angle sought for.

Thus these two angles being found, the angle at A 30 and the angle at B 45, these added together make 75 which substracted out of 180 there remains 105 d. for the angle at C, and so you may find the side opposed thereto, by the former rule in the 8 Case.

The 10 and 11 Cases.



10 *Case.* Two sides with the angle contained being given; to find the angles. 11 *Case.* And also to find the third side.

In the triangle A C D, let the side A C be known to be 41, and the side A D 56, and the angle between them at A 30 d. and it is required to find the other angles at C and at D, and also the side C D,

As the summe of the sides A C 41 and A D 56 97
To the difference of the said sides 15
So the tangent of halfe the angles unknown 75 d. 37321
To the tang. of the difference of the angles 30 d. 5771

Which

Which added to the halfe of the angles ſhews the greater angle; and ſubſtracted from it, ſhews the leſſer angle.

And thus having all the angles, the ſide will be found as in the 8 Caſe by the oppoſite angle.

But it will be as good a way to reduce this oblique triangle into two right triangles; which may thus be done by letting fall the perpendicular C B. To performe which.

1 For the right angle A B C you have the Hypothenuſal A C 41, and the angle at A 30 d. therefore by the firſt Caſe the two ſides will be C B 20.50 parts, and A B 35.51 parts, or 35 $\frac{1}{2}$.

2 Then ſubſtract this ſide 35.50 parts, from the whole line A D 56, there remains 20.50 parts, and thus you have the two ſides of the other right angle C B D, C B being 20$\frac{1}{2}$, B D 20$\frac{1}{2}$, and ſo by the fourth and fifth Caſes, the tangent of either angle is 45 deg. and the ſecant thereof 29, will be the third ſide. And thus you ſhall not onely have the ſaid ſide and angles, but all the other parts of the Triangle.

half	75
	30
added	105
ſubſt.	45

In this operation, ſometimes the perpendicular will fall without the triangle, (which muſt needs be ſo, when you have an obtuſe angle contained between the two given ſides,) then the worke may ſeem to be otherwiſe, but it is the ſame in effect. A ſecond Example of theſe two caſes.

As in the triangle A E C, ſuppoſe the two ſides A E 15, and E C 29, and the angle between them being 135 degrees were onely known, and it were required to find the other ſide and the angles.

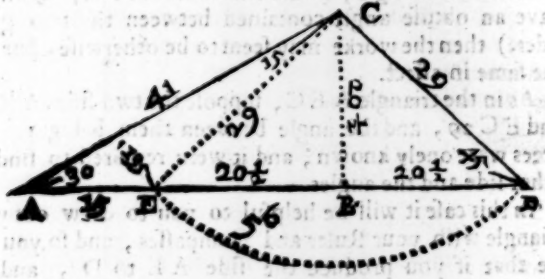
In this caſe it will be helpful to you to draw out your triangle with your Ruler and Compaſſes, and ſo you will ſee that if you produce the ſide A E to D, and let fall the perpendicular from the point C, it will fall at B, without the triangle aforeſaid. And thus you have the right angled triangle E C B, whoſe Hypothenuſal A C, is known to be 29, and the angle at E, muſt needs be the complement of the obtuſe angle given, to 180 degrees, which being 135 deg. this is 45 deg. and thus having

this angle and the Hypothenusal, you shall find the sides of this right angled triangle, by the first case. The perpendicular side being $20\frac{1}{2}$, and the side E B to be $20\frac{1}{2}$. Thus you have one right angled triangle E C B.

Now for the other right angled triangle A C B, adde the side E B $20\frac{1}{2}$ to the side A E of the Oblique triangle, which was 15, it makes the whole line A B to be $35\frac{1}{2}$. And thus you have the two sides of the other right angled triangle, *viz.* the perpendicular C B, $20\frac{1}{2}$, and the side A B $35\frac{1}{2}$, and so by the fourth and fifth cases making A B the Radius, you shall find the angle at A to be 30 degrees, and the secant thereof shews the side A C to be 41. Thus you have all the three sides of the triangle A E C, and two of the angles, *viz.* the angle at A 30 deg. and the angle at E 135, and the angle at C is the complement of these two to 180 degrees, which must needs be 15 degrees.

The 12 Case.

Having the three sides to find the angles.



In this triangle A C D let the three sides be known,

	The side A C	41
viz.	The side C D	29
	The side A D	56

And

And it is required to find the three angles thereby.

To performe this, you muſt firſt let fall a perpendicular from the point C upon the ſide A D, which you may doe by ſetting one foot of your Compaſſes in the point C, and opening the other to the point D, draw the arch D E, and marke where this arch cuts the line at E, and divide the ſpace E D into two equal parts, ſo the perpendicular will fall upon the point B.

But to perform this more exactly by numbers.

As the greater ſide A D	56
To the Summe of the other two 41 and 29	70
So the difference of theſe two ſides	12
To the part A E cut off by the arch D B E	15

This ſubſtracted from the whole line 56, leaves for the part within the arch 41, the halfe whereof is 20 $\frac{1}{2}$, which is the place B, where the Perpendicular will fall, reckoned from the angle D, and by this Perpendicular you have divided the triangle into two right angles, whoſe ſides are known; for D B being 20 $\frac{1}{2}$, ſubſtracted from the whole line A D 56, leaves for the remaining part B A 35 $\frac{1}{2}$.

Now having theſe two ſides, of theſe two right angled triangles, and the two firſt given ſides 29, and 41 being the two hypothenuſals thereof, you may either by the oppoſition of ſides to their angles as in the 8 Caſe, or by ſides and hypothenuſall, as in the ſixth Caſe find the angles.

Theſe are all, or the moſt needfull Caſes, in the reſolution of plain triangles: which might have been ſet forth with much variety, and inlargement: but I rather ſtrive to ſhew the beſt and plaineſt way. And if any thing herein prove difficult, it is ſuch caſes as there will be of leaſt uſe in our intended buſineſſe of Navigation.

CHAP.

CHAP. III.

Of ſayling by the Plain Chart.

HAving premiſed ſome things in the former Chapters, neceſſary for the underſtanding of the ground worke of the tables, and the reſolution of plain triangles in general: I ſhall now ſhew the particular application thereof in the moſt uſeful queſtions, of Navigation. And herein I ſhall not multiply many needleſſe queſtions, nor ſtrive to branch them out into their ſeveral varieties; but firſt ſhall give you thoſe which are moſt uſual and neceſſary, and then (if occaſion permit) ſhew you ſome which may be leſſe uſual, as briefely as I can.

The firſt Propoſition.

The firſt and moſt uſual queſtion in Navigation, is this; By the knowledge of the Rumb or Courſe you ſayle upon; and the diſtance of Miles, Leagues, &c. that you ſayle thereon: to know your difference of Latitude, and Longitude? That is, how much you are more Northerly or Southerly, in reſpect of Latitude? and how much you are more Eaſterly or Weſterly in reſpect of Longitude?

The way of keeping an account by Traverſe or dead reckoning.

This is the moſt ordinary manner of keeping an account of the ſhips way, which is uſually called the dead reckoning. And to keep this account, firſt you ſee, that the knowledge of the Rumb they ſayle upon is alwayes ſuppoſed to be had, becauſe the Compaſſe by which they ſteer, either doth, or ſhould ſhew the ſame exactly. And therefore to this purpoſe, the Sea-man ought to be very careful of his Compaſſe, that it be exactly made, and skillfully ordered in reſpect of the variation, which in moſt places it is ſubject to: which muſt be carefully found out, and allowed

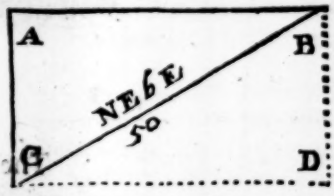
ed for. Secondly, for the keeping this account, you muſt alſo know how many Miles, Leagues, or hundred parts of a degree your ſhip ſayles upon this Rumb or point of the Compaſſe: which you muſt find out by the Log-line, or ſome other way, of which you may ſee ſomewhat in the 3. Chapter, and 3. Propoſition of the *Geometrical Sea-man*, and I ſhall ſhew you more hereafter, in the latter end of this Book.

Theſe two things being known, if you worke by Calculation the Rule is this; As the Radius; to the Diſtance ſayled either in Miles, Leagues, or degrees; So is the Coſine of the Rumb from the Meridian, to the difference of latitude in the like parts.

And againe; As the Radius to the diſtance ſayled; So the Sine of the Rumb to the difference of longitude.

But the way of working by theſe tables is thus, far more readily.

Firſt, find the angle of the Rumb at the top of the table; and find the number of the Miles or Leagues, or Centeſmes of the ſhips way in the ſide of the table; and in that line under the title of Sines, you ſhall find how much you differ in Latitude in that column, which is under the angle of the Rumb; and how much you differ in Longitude in the other column, which is under the Complement or Coſine of the angle of the Rumb.



Thus in this triangle A B C, ſuppoſe the angle at C to be 56 deg. or the fifth Rumb from the Meridian *viz. N E by E* let the diſtance ſayled thereupon be C B, which ſuppoſe to be 50 leagues. The queſtion is, to know how much the point B is Northward from the Parallel C D, which is the length of the line C A, or D B. And likewiſe how much the ſaid point B is Eaſtward from the meridian A C; which is the length of the line A B, or C D.

Firſt,

First, take the table, and find out the angle of the Rumb, which is 56 deg. then look down the ſide of the table till you find your number of Leagues ſayled, which in this Example is 50 Leagues, which you ſhall find in the laſt line of the left hand page, and in that line, in thoſe two columns, under the title Sines, you ſhall find 41.45 and 27.96, which ſhews that the longeſt of theſe lines muſt be 41 leagues, 45 hundred parts, or almoſt an halfe; and the other line C A being the Northerly diſtance, muſt be 27 Leagues 96 hundred parts, or almoſt 28 leagues.

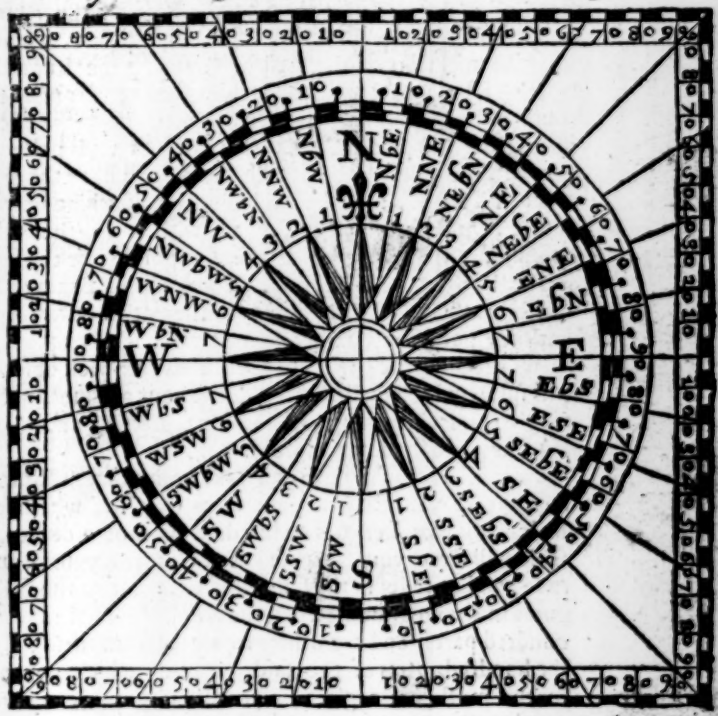
To know which column ſhews the difference of latitude; and which the difference of longitude.

But now here may be ſome ſcruple to thoſe that are not practiſed herein, to know which of theſe numbers belong to either line. This may be more eaſily known to thoſe who have skill in theſe things, if they conſider whether their Rumb, runs out more in Longitude then in Latitude. As for younger Seamen this Traverſe Quadrat of the Rumbs, with the directions thereto, will more plainly ſhew it, then many words; which if well conſidered is the ſubſtance, and ſhews the nature and work of all the tables.

By this you ſee that the 5 Rumb from the Meridian, or *NE by E*, runs more in Longitude then in Latitude, therefore your Northing is 28 leagues, and your Eaſting 41 leagues and an halfe.

The

The Traverſe Quadrat.



But that this might be the more readily known, I have (for this very thing) which doth well deſerve it) tranſpoſed the order of this table of Sines. For whereas the greater angle ſhould require the greater ſide, yet here the greater

Obſerve this well, for it is of ſo great uſe, that for this very cauſe I have tranſpoſed the columns of Sines, according to Mr. *Norwoods* Example, which I think was his reaſon for ſo doing, though I do not find him any where mentioning of it.

ſide is placed ſtill under the leſſer angle. And my reaſon is this; The Rumb being alwayes reckoned from the Meridian line, the difference of Latitude falls out allwayes according to the complement of the Rumb; and the difference of Longitude according to the Sine of the Rumb; which ſeemes contrary to our uſual expreſſions, wherein we make mention of the Latitude, ſaying the Rumb lies North-eaſterly or North-weſterly ſo many degrees; or South-eaſterly, or South-weſterly ſo many degrees; therefore I have thus placed them, that alwayes under the degree of the angle of the Rumb, you ſhall have the difference of Latitude; or the Northing or Southing of your courſe, and the number joyned with it in the other column, is the difference of the Longitude, or the Eaſting or Weſting of the courſe. Thus in this Example the number under 56 deg. being 27.96 ſhews the difference of Latitude; and the number joyned with it, being 41.45, ſhews the difference of Latitude. This rule well obſerved will fully guide you in ſetting down your account, according to your Northing and Southing, Eaſting and Weſting, as you ſhall ſee more annon.

Here alſo I would have you take notice that what meaſure ſoever you account your ſhips way in, whether in Miles, Minutes, Leagues or hundred parts of a degree, the table will ſerve your purpoſe, and give you your Longitude and Latitude, in the ſame kind of meaſure, the firſt figures in the column ſhewiwg the whole Miles, Leagues or hundred parts, and the others ſeparated from them, ſhew the hundred parts of the ſaid meaſure, which you may for the moſt part neglect, eſpecially if you reckon your way in miles minutes or hundred parts of a degree: or at leaſt if they be leſſe then 50 parts, or halfe an Integer you may neglect them altogether; if they be more then 50, then count one more to your number of miles, minutes, or hundred parts.

Thus the foreſaid 50 leagues make 150 miles, or minutes, reckoning 60 miles or minutes to a degree, and ac-

according to this account the table will ſhew you.

Rumb *NE* 56 deg.	*North*	*East*
for 100 miles	55.92	82.90
for 50 miles	27 96	41.45
which makes miles	83.88	124.35

That is difference Latitude 1 deg. 24 min.
Difference Longitude 2 deg. 04 min. *ferè*

But the beſt way of account will be by hundred parts of a degree, and therefore though (you ſee) I do not enforce you, yet I would perſwade you to make your Log line ſo that it may ſhew your ſhips way in Centeſmes of a degree; for then the work will need no reduction, but be very ready.

Thus the foreſaid 50 leagues, being 2 degrees and an half, or 2 deg. 50 *Cent.*

Rumb *NE* 56 deg.	*North*	*East*
	D. C. pts.	*D C. pts.*
2 degrees, or 200 *C.*	1 12 00	1 66 00
50 *C.*	27 96	41 45
	1 39 96	2 07 45

Or if you think this way ſomewhat long, you may do it at one entrance into the tables, with a little conſideration: for if inſtead of 2 degrees 50 *C.* you take 25, you ſhall find in the table 13.98, and 20.71, which by adding a cypher in the laſt place, and ſo putting the figures a place forwarder, will be 1 *D.* 39 *C.* 80 *pts.* and 2 *D.* 07 *C.* 10 *pts.*

But as I ſaid before, theſe leſſer 100 parts may be neglected, and ſo it will be 1 deg. 40 parts, and 2 deg. 07 parts.

And thus having found out the difference of Longitude and Latitude of the place you are come to, by adding it to,

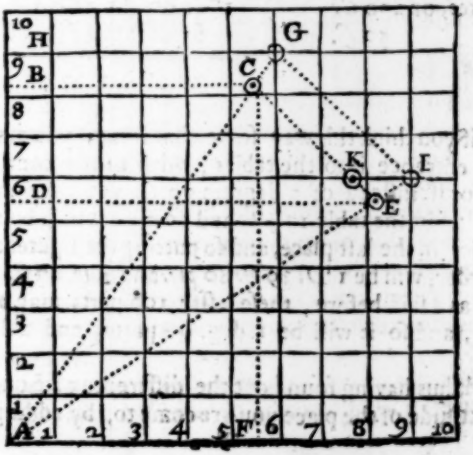
or ſubſtracting it from, the Longitude and Latitude of the place you come from, you ſhall know the Longitude and Latitude of the place you are in at any time, and ſo readily ſet it down upon any graduated Chart or Map, and from thence ſee how you are to ſteer your next courſe.

And as you may doe thus for one ſingle courſe, ſo you may do for as many as you will, ſetting them down in the table; and if you make a blanck Map of your voyage according to your table, as you goe along, they will helpe one another; for your Map will ſhew you when to add and when to ſubſtract, and your table will ſhew you, the Longitude and Latitude of the places exactly, by which you may as truly (but much more readily) make your points (even by the eye) as by any Scale or Protractor: But of this you ſhall ſee more largely in the following Propoſitions.

The Second Propoſition.

By the difference of Latitude and Longitude; to find the Rumb, and the diſtance between any two places.

In this figure ſuppoſe the place you are in to be A (being under the Equinoctial, and ſo having oo deg. or no



deg.

deg. either of Latitude or Longitude: and ſuppoſe you are bound to the place C, having 8 deg. 30 Centeſmes of latitude, and 5 deg. 60 Centeſmes of Longitude; The queſtion is to find the Rumb, between the two places? and the diſtance in the Rumb?

Here you ſee the triangle which you are to reſolve, is the triangle A B C, where in you have the ſide A B given, which is the difference of Latitude, 8 deg. 30 parts; and alſo the ſide B C is given, which is 5 deg. 60 parts, being the difference of Longitude; and there are two things required, that is the angle of the Rumb, being the angle at A, and the diſtance of the two places being the line A C.

Here you muſt underſtand that theſe two ſides of the triangle A B, and B C, are as tangents, and the line A C is the Secant of the triangle; and to find the angle of the Rumb, you muſt alwayes make the ſide of Latitude your Radius, and the proportion will be thus,

As the ſide A B 8 deg. 30 parts, or 830
To the Radius,
So the ſide B C 5 deg. 60 parts, or 560
To the tangent of the angle of the Rumb 67407,34 deg.

And then,

As the Radius	
To the ſide of Latitude;	830
So the ſecant of the angle	12063
To the ſide of diſtance.	1001.

But now to work this by the tables; take your difference of Latitude A B 830, or caſting away the cypher, take the number 83 for your marginal number, and turne over your tables till you find the other line B C, being 560 or 56, right againſt it, under the title of tangents (which you may eaſily do by the ſucceſſion of the numbers, as you muſt do in any other table) and where you find theſe two numbers meet thus in one line; the degrees at the head

head of the columns, will ſhew you the angle of the Rumb, and the ſecant in that line alſo, will ſhew you the diſtance.

Thus in this Example if you turn over the table, you ſhall not find the numbers agree till you come to 34 deg. and in that leafe, juſt againſt 83 in the margent, you ſhall have 55.98 parts, which is very neer 56, under the ſaid tangent of 34 deg. this is the true angle therefore of the Rumb, being very neer the third Rumb from the Meridian, as you may ſee alſo in the margent of the tables.

And now for the diſtance of theſe two places, look in the ſame line againſt 83, and the ſaid ſecant under 34 deg. is 100.12 which is the diſtance.

Only thus you muſt underſtand it, that in the ſame ſort of parts which you make your ſide of latitude to conſiſt of, the ſame parts muſt you reckon your diſtance in. So that if you reckon;

A B to be 83, then A C is 100,
If A B be 830, then A C is 1001,
If A B be 8 d. 30 parts, then A C is 10 d. 01 parts.

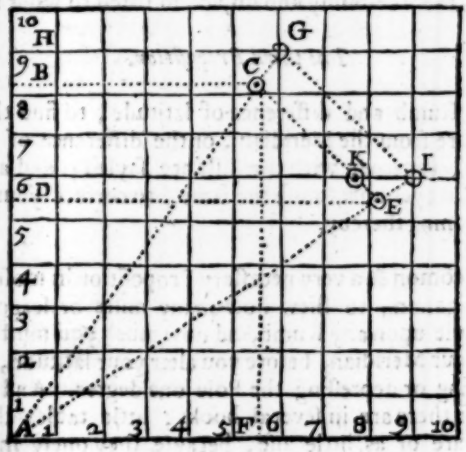
And thus let the difference of latitude be under a degree, or more then a degree, or many degrees, the way of working is all one, onely in the different denomination of the numbers which you find in the table.

To make this a little more plain to you, and alſo to prevent a miſtake; Suppoſe you were at the place C, whoſe latitude is 8 deg. 30 parts, and longitude 5 d. 60 pars, as before; and you would know the Ruub from C to A, and alſo the diſtance.

In this caſe though the angle at C be the complement of the angle at A, in the foreſaid triangle A B C, yet this is not the Rumb from C to A, for the Rumb muſt be alwayes reckoned from the Meridian line. And therefore being at C, your Meridian line is C F, and ſo the triangle you are now to reſolve, is the triangle C F A, where in

C F

C F the difference of latitude being 8 deg. 30 parts, and A F the difference of longitude being 5 deg. 60 parts, as before; the Rumb will alſo be found to be the third from the Meridian, or an angle of 34 deg. and the diſtance 10 deg. as before: onely the Rumb falls on the oppoſite ſide of the Compaſſe, the Rumb from A to C being *N E by N*, and the Rumb from C to A being *S W by S*.



But yet if you have a mind to find the angle at C of the triangle A B C, and the length of the ſecant line C A that way alſo, you muſt make the line C B your Radius, which being 5 deg. 60 parts or 56, find this in the margent and turn till you find the other line B A 83, in the tangents: this you ſhall have under the angle 56, where againſt 56 in the margent, you ſhall find 83.04 for the tangent, and the ſecant thereof in the ſame line alſo is 100.15, the ſame as before without any ſenſible difference in theſe accounts.

Thus you ſee you may find theſe angles, and the line

A C

A C being the diſtance, either of theſe wayes; but the firſt is the moſt proper, and uſeful; For when you make the ſide of latitude your firſt number, then the other ſide is the tangent of the Rumb you are to ſayle upon; whereas taking the other ſide firſt, the angle found will be the complement of the Rumb, and ſo muſt be ſubſtracted from 90 deg. which though it be not much labour, yet it is needleſſe. And beſides in moſt of theſe caſes the latitude is more certainly known, and ſo fitteſt to wokr by.

The third Propoſition.

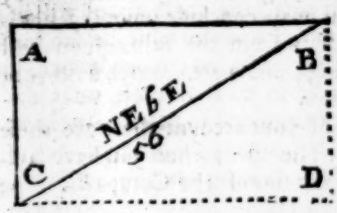
By the Rumb and difference of latitude, to find the departure from the Meridian, or the difference of longitude, together with the diſtance ſayled; and alſo ſeveral wayes how to uſe the ſame, to correct your dead reckoning thereby.

It is a cõmon & a very neceſſary Propoſition in moſt books of Navigation, to ſhew how many miles or leagues you muſt ſayle upon any Rumb, and how much you muſt depart from your Meridian, before you alter your latitude, either by raiſing or depreſſing the Pole one degree. And to this purpoſe there are in ſeveral books, little tables thereof, which are of as little uſe, becauſe they onely ſhew the the things deſired onely for one degree of latitude; ſo that if your difference of latitude be either more or leſſe then juſt one degree, the Tables ſhews little or nothing, but you muſt have recourſe to the Rule, and ſo calculate it by the Doctrine of Triangles.

But theſe Tables are of excellent and ready uſe for this purpoſe, for let your alteration of latitude be any number of parts whatſoever under 100, or one degree; the Tables ſhew it exactly; for if you turn to the degree of the Rumb; and there find the difference of latitude in the margent; the tangent thereof will ſhew the difference of your Meridian, or longitude, and the ſecant of that angle will

ſhew

ſhew you the diſtance ſayled in the ſame parts, without any farther trouble, more exactly then any other Table made for this very purpoſe, which hitherto hath been publiſhed.



Thus in this Triangle A B C the angle of the Rumb at C being 56 deg. let the difference of latitude CA be 20,40,60,80, or 100 parts; the departure, and the diſtance will be as in the Table of Tangents and Secants.

Thus the Angle being 56 deg.

C A the	20 *pts.*	The Tangent	29 *pts.*	65	And the	35 *pts.*	77
difference	40	hereof ſhews the	59	30	Secant	71	33
of lati-	60	departure from	88	96	ſhewes	107	30
tude be-	80	the meridian or	118	61	the di-	143	06
ing	100	longitude.	148	26	ſtance.	178	83

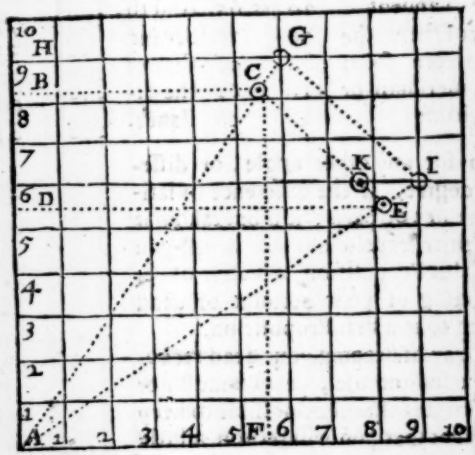
The like you may do for any other angle, or difference of latitude under a degree, If the difference of latitude be more then a degree or 100 parts, it is but taking it out at twice, as in the former concluſions, of which you ſhall ſee more in the uſe of this Propoſition, which is of very great uſe in the correcting of your account of dead reckoning, made according to the firſt Propoſition.

For though the foreſaid way of keeping your dead reckoning be of very great and conſtant uſe, yet you muſt not altogether truſt unto it: For it is almoſt impoſſible to keep this reckoning ſo exactly, but that you will reckon a little too much or too little; becauſe you cannot give ſo true an eſteemate of the ſhips way, but that in a day or two, or in ſayling 100 or 200 miles, you may very well miſreckon 10 or 20 miles. Sometimes alſo ſome unknown current may ſet you more forward or backward then you reckon, by as much or more. And therefore for the proof,

This is the beſt way to rectifie your account, by obſervation of the latitude, with good inſtruments, which carefully uſed may be obſerved to a ſmall matter.

and alſo for the correction of your dead reckoning, you muſt be careſull as often as you can, to make exact obſervation of your latitude, either by the Sunne or Stars; and if the latitude thus obſerved, agree with your latitude by dead reckoning, then you may conclude your account is right: But if the one differs from the other, you muſt correct your dead reckoning, and make it agree with your latitude taken by obſervation.

Now in this rectifying of your account there are theſe two caſes to be conſidered. The one is when you have ſayled onely upon one Rumb or point of the Compaſſe. The other is when you have ſayled upon two or more Rumbs, and ſo your way doth not lie in a right line. For the firſt of theſe caſes.



How to rectifie your account, when you have ſayled onely uponone point of the Compaſſe.

Suppoſe you had ſayled from A to C upon the third Rumb, or *NE* 34 deg. about the diſtance of 10 degrees, and ſo by your dead reckoning ſhould be in 8 deg. 29 parts of latitude, and 5 deg. 59 parts of longitude from A; But now ſuppoſe that by obſervation of the latitude, you find your ſelfe to be juſt in 9 deg. of latitude, and therefore as you are gone further in latitude, ſo you muſt needs be further in longitude alſo, being at G, and therefore you deſire to know the true lõgitude, as well as the true latitude of this place, and alſo how far you are ſayled from the place A.

Turn to the angle of your Rumb, and find your difference of latitude in the margent, and in that line, the

Tan-

Tangent number belonging to that degree, ſhews the difference of longitude, and the Secant number in that line alſo, ſhews the diſtance you have ſayled.

Thus in this Example if you turn to the angle of your Rumb, which is 34 deg. and there in the margent find your difference of latitude which is 9 deg. the tangent againſt 9 in this line is 6.07, which ſhews the longitude is 6 deg 07 parts, and the Secant in this line under 34, is 10.86, which ſhews the diſtance ſayled is 10 deg. 86 parts. And thus you have the true longitude, latitude, and diſtance of the place G from the place A.

I know this might be performed by the Tables of Sines onely, as Mr. *Norwood* ſhews. But then the diſtance muſt be leſſe, and the numbers will not be ſo exact.

In this caſe it will be beſt many times to work by the difference of the latitude, and not by the degrees, ſo the work will be ſomewhat more exact.

Your latitude by dead reckoning was 8 d. 29 parts.
Your latitude by obſervation is 9 d. 00 parts.
The difference between them is 0 d. 71 parts.

Find this 71 parts, in the margent; and under the angle of your Rumb 34, you ſhall find the Tangent is 47.90, and the Secant thereof is 85.64, which added to your fore-ſaid account as it ought to be, your true account will be thus.

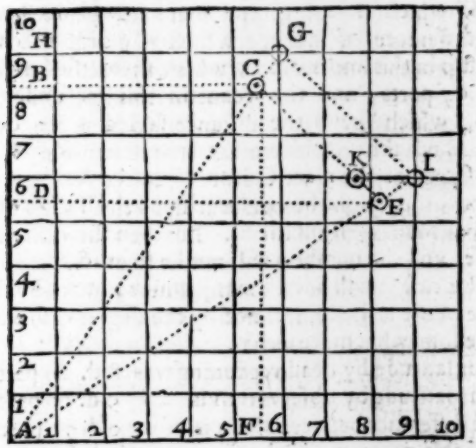
	Diſtance			*Latitude*			*Longitude*		
Dead reckoning	10 d.	00 c.	00 pts.	8 d.	29 c.	0 pts.	5 d.	59 c.	0 pts.
The difference		85	64		71	0		47	90
The true account	10	85	64	9	00	0	6	06	90

The ſecond caſe is when you have ſayled upon two or more ſeveral points of the Compaſſe before you can come to have a good obſervation of the latitude. In this caſe, you muſt firſt find out upon what Rumb or angle, the place you are in by your dead reckoning, doth lye from the place you came from, or from the laſt place where you rectified your account: and this muſt be the Rumb or angle, by which you muſt correct your account,

How to rectifie your account when you have ſayled upon two or three points of the Compaſſe.

and not that which you laſt ſayled upon.

As for Example.



Suppoſe you ſhould ſayle from A to C, *N E by N*, or *N 8* 34 degrees to the diſtance of about 10 degrees, and ſo ſhould be at C according to your dead reckoning; but according to the true account you ſhould be as far as G, as in the laſt. And then from this point C which you think you were in, you ſhould ſayle *S E*, or upon the angle of 45 deg. to the diſtance of 3 degrees 80 parts; ſo you would count your ſelfe to be at E, whoſe latitude is 5 d. 60, and whoſe longitude is 8 deg. 30. But here now obſerving the latitude, you find that you are in 6 degrees 07 *C. pts.* of latitude, ſo that there is 47 *C. pts.* of latitude difference between the dead reckoning, and the obſervation. And as there is this difference of latitude, ſo there muſt needs be a good difference in longitude: Now the queſtion is how, or which way the longitude ſhould be corrected? Here

Here you ſee; your dead reckoning, gives your account from A to C, and then from C to E, and now if you ſhould correct your account upon this laſt Rumb from C to E, then you ſhould account your ſelfe to be in the place K, which hath 6 degrees 07 parts of latitude, and 7 deg. 83 parts of longitude. But this cannot be a true correction. For as you were at G, when you thought you had been at C; ſo ſayling from the point G, South-Eaſt till you come to 6 deg. 07 parts of latitude, you muſt needs be in the place I, and therefore neither in E, nor in K. But now all the difficulty, is how to find this place I, which is the true place you are in, if you did not know the foreſaid correction, at G.

This Propoſition is very conſiderable, and yet is not mentioned in any other book but in my *Geometrical Seaman*.

To this purpoſe as I ſaid before, you muſt find the angle of the Rumb, from A to E, which is the place you are in according to your dead reckoning, and finding where this Rumb croſſeth the Parallel of 6 deg. 07 parts, which is your latitude by obſervation, you ſhall find it to be in the place I, and this is the true place where you are.

Now to find the angle of the Rumb from A to you, by the Second Propoſition of this Chapter, obſerve the triangle A D E, wherein you have the difference of latitude of the two places, A D 5 deg. 60, and the difference of longitude D E 8 deg. 30. Therefore turn over the Tables, till you find 8 deg. 30 parts, (or 83, which comes all to one) in the column of tangents, againſt 5 deg. 60 (or 56) in the margent, which you ſhall find exactly under the angle of 56, where againſt 56 in the margent you ſhall have 83.04, for the Tangent of 56, this therefore you may conclude is the angle of the Rumb from A to E, being *NE* 56 deg. or the fifth Rumb from the meridian.

Having thus found the angle of the Rumb you are to work upon, conſider the difference of latitude between your dead reckoning, and your obſervation. The dead reckoning gives 5 deg. 60 C. parts, but the obſervation is 6 deg. 07 parts of latitude, ſo the difference is 47 *C. pts.* Now if you find this number 47 in the margent under the fore-

foreſaid angle of 56, you ſhall have for the Tangent 69.70, that is 70 *C.* parts *fere*; which is the difference of your longitude. Now this added to your former account, your true account will be thus.

	The Latitude	*The Longitude*
By dead reckoning	5 d. 66 *pts.*	8 deg. 30 *pts.*
The difference	47 *pts.*	70 *pts.*
The true place	6 07	9 00

Thus this way though it may ſeem a little troubleſome at the firſt, yet it may be of very good uſe, and gives the true correction, which you ſee differs above a * degree from the correction you ſhould make upon the Rumb you ſayled laſt upon; and this muſt needs alwayes give the exact place, if your difference of way upon both Rumbs, be both alike, or any thing proportionable to each other: And ſo they muſt needs be, if there be no unknown current, which may ſet you more forward or backward upon one of the Rumbs, then upon the other, of which alſo I ſhall give you ſome obſervations in their place.

d.
1.17

CHAP. IV.

Shewing a method for the keeping of an account at Sea, according to the former Rules.

THe three former propoſitions, as they are the moſt uſefull, ſo you need almoſt make uſe of no other, if you will content your ſelfe to keep your account according to the Plain Chart. And therefore in this Chapter I have little more to ſhew you then in the laſt, onely there I laid down the Propoſitions ſeverally, here I ſhall make uſe of them together.

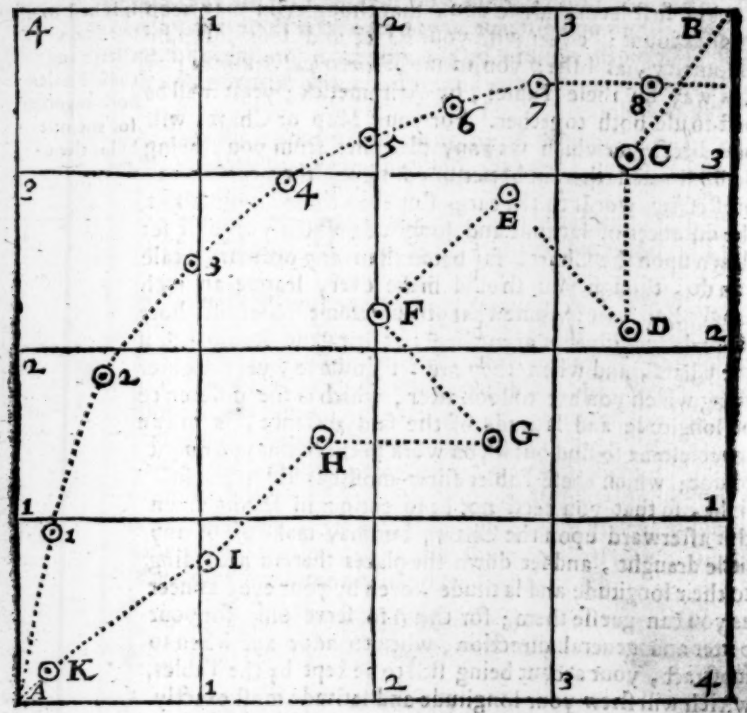
And

And firſt let me adviſe you, that though you may keep your account; either with your Ruler and Compaſſes by Geometry, as I ſhew you in my *Geometrical Sea-man*; or this way by theſe Tables, by Arithmetick; yet it will be beſt to uſe both together. For your Map or Chart, will beſt direct you which way any place lies from you, being demonſtrated therein better to your eye, then can be expreſſed by words to the ear; But then theſe Tables ſhew the diſtances of latitude and longitude which you muſt ſet down upon the Chart, far better than any ordinary Scale can do, though you ſhould make every league an inch long. Beſides it is ſomewhat troubleſome to ſet off thoſe ſmall daily diſtances according to their true Rumb upon the Chart, and when they are ſet down ſo, yet the chief thing which you are to look after, which is the difference of longitude and latitude of the ſaid diſtance, is more troubleſome to find out if you work ſo exactly as you ought to doe; which theſe Tables ſhew moſt exactly at the firſt ſight, ſo that you need not be ſo curious in ſetting down this afterward upon the Chart, but may make uſe of any little draught, and ſet down the places therein according to their longitude and latitude, even by your eye, as neer as you can gueſſe them; for this is to ſerve only for your better and general direction, when to adde and when to ſubſtract, your accout being ſtill to be kept by the Tables, which will ſhew your longitude and latitude moſt exactly. Thus theſe two wayes joyned together, will much help each other, and be the beſt way for the keeping of your account at Sea that you can uſe.

It is beſt to uſe the Plain Chart and theſe Tables both together, for the one helps the other.

As for the making of the Plain Chart it is moſt eaſie, making the degrees of latitude and longitude equal every way, ſo that the figure thereof, without any farther direction, is enough. But you may ſee more in my *Geometrical Sea-man* Chap. 3.

As



As for the framing of the Table of your account, it is very plain; ſo that you may any time make the like. it is only divided into 10 columus, whoſe titles expreſſe in ſhort what they ſtand for, *viz.*

The firſt ſhews the places of your Harbouring or Obſervation.

The ſecond ſhews the Rumb from one place to the next

The third the angle of the Rumb, with allowance for the variation when there is need of it.

The fourth the diſtance or way ſayled in Leagues, Miles or Centeſmes.

The

The four next columns ſhew the *N. S. E.* or Weſting of that Rumb, and diſtance, as you find it in theſe Tables.

The ninth column by the Addition or Subſtraction of the Northing and Southing, ſhews the latitude of any of the ſaid places.

The laſt by the Addition or Subſtraction of the Eaſting and Weſting, ſhews the longitude of any of the ſaid places.

The places.	Courſe.	Angle Rumb	Diſtā *C. pts.*	North *C. pts.*	South *C. pts.*	East *C. pts.*	Weſt *C. pts.*	Latit. *D. pts.*	Longit *D. pts.*
The place A.		d.						0 0	0 0
from A to 1.	*N by E*	*NE* 11	100	98		19		0 98	0 19
from 1 to 2.	*N N E*	*NE* 22	90	83		34		1 81	0 53
from 2 to 3.	*NE by N*	*NE* 34	80	66		45		2 47	0 98
from 3 to 4.	*N E*	*NE* 45	70	49		49		2 96	1 47
from 4 to 5.	*N E by E*	*NE* 56	60	33		50		3 29	1 97
from 5 to 6.	*E N E*	*NE* 68	50	19		46		3 48	2 43
from 6 to 7.	*N by E*	*NE* 79	50	09		49		3 57	2 92
from 7 to 8.	*East.*	90	65	00		65		3 57	3 57
			5.65	3.57		3.57			

Here you ſee the firſt place A, *is ſuppoſed to be under the Equinoctial, having* 0 deg. 00 min. *of Latitude or Longitude.*

In the next place from this place A, to the point 1, the Courſe being the firſt Rumb from the Meridian *N by E*, or *NE* 11 deg. and the diſtance thereon 100 *C. pts.* of a degree. If you look this angle of 11 deg. in the Table, you ſhall there find the Northing of theſe 100 *C. pts.* is 98 *C. pts.* and the Eaſting 19 *C. pts.* (omitting the leſſer parts in the Table as needleſſe.) And ſo the Latitude of this place will be *North* 0 deg. 98 parts, and the Longitude *Eaſt* 0 deg. 19 parts.

The example in the tables and Chart explained.

Then the ſecond courſe from 1 to 2 being *N N E* the ſecond Rumb from the Meridian or *N E* 22 deg. ½, and the

diſtance therein 90 *C. pts.* turn to this angle of * 22 deg. or 23 deg. in the Table, you ſhall find for 90 *C. pts.* the Northing is 83 *C. pts.* and the Eaſting is 34. Now the Northing of this place, added to the Latitude of the former, and the Eaſting of this place added to the Longitude of the former, ſhewes the true Latitude and Longitude of this place.

* the angle being 22 ½, you may either take the 22, or 23 deg. the difference will not be much: or if you will, you may proportion it by the diffetence between them, as theſe numbers are.

The Latit. of the laſt place	0 deg. 98	The Longit	0 d. 19
The Northing of this place	83	The Eaſting	34
So that the Latit. of this place is	1 d. 81	and the Long.	0 d. 53

Thus the Table all along will ſhew you the Longitude and Latitude of the place you are in, by which you may at any time ſet it down upon your graduated Chart, and ſo better ſee whereabouts you are, and how to direct and account your following courſe.

Only take notice that where as in this Example you have alwayes added the Longitude and Latitude of the following places to the former, becauſe the Longitude and Latitude thereof is ſtill ſuppoſed to increaſe; ſo when your Longitude and Latitude doth decreaſe, you muſt uſe ſubſtraction; and if the one doth increaſe, and the other doth decreaſe, you muſt accordingly uſe Addition in the one and Subſtraction in the other. In all which the very looking upon your *Map* or Chart, and conſidering of your courſe, with a little practice, will be very plain unto you. And yet for your better inſtruction in this ſo neceſſary a buſineſſe, I have added this Example, wherein you ſhall ſee moſt of theſe varieties, that can happen in your account. And though ſome may think this needleſſe, yet I deſire herein to be ſo plain, that every one may underſtand it. And withall take notice that this variety of operation ſometimes by Addition, ſometimes by Subſtraction; is not cauſed by reaſon that you work by theſe Tables; But whatſoever way you work to find out the difference of longitude

tude and latitude, you muſt according as the Courſe requires, make ſometimes Addition, and ſometimes Subſtraction as you do here.

The places.	The Rumb or Courſe.	Angle of it	Diſtã *C. pts.*	North *C. pts.*	South *C. pts.*	East *C. pts.*	Weſt *C. pts.*	Latit. *D. pts.*	Longit. *D. pts.*
The place B.		d.						4 00	4 00
from B to C.	*S W by S*	*S W* 34	100		83		56	3 17	3 44
from C to D.	*S*	*S* 00	100		100		00	2 17	3 44
from D to E.	*N W*	*N W* 45	100	71			71	2 88	2 73
from E to F.	*S W*	*S W* 45	100		71		71	2 17	2 02
from F to G.	*S E*	*S E* 45	100		71	71		1 46	2 73
from G to H.	*W*	*S* 00	100		00		100	1 46	1 73
from H to I.	*S W*	*S W* 45	100		71		71	0 75	1 02
from I to K.	*S W by W*	*S W* 56	100		56		83	0 19	0 19

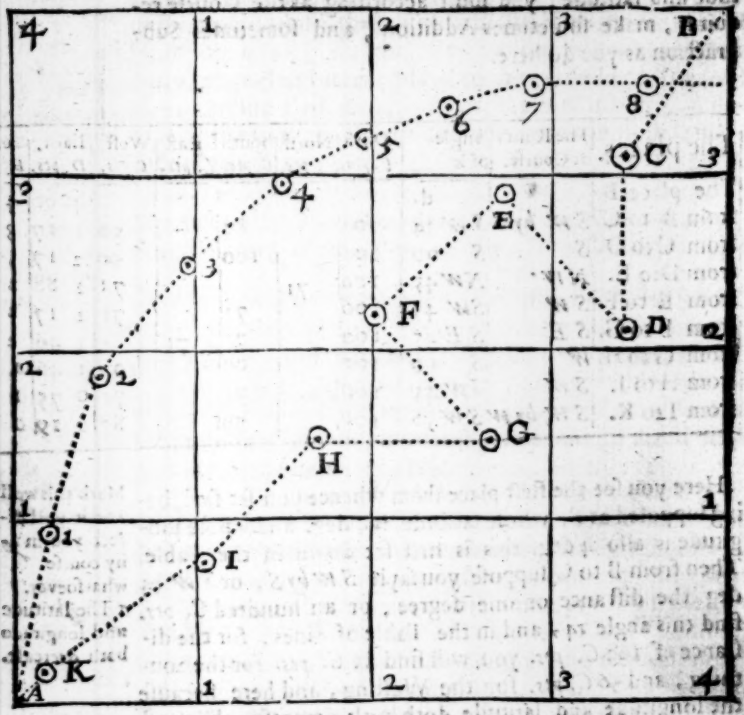
Here you ſee the firſt place from whence you ſet ſayl, being ſuppoſed at B, whoſe latitude is 4 deg. and whoſe longitude is alſo 4 deg. this is firſt ſet down in the Table. Then from B to C ſuppoſe you ſayle *S W by S*, or *S W* 34 deg. the diſtance of one degree, or an hundred *C. pts.* find this angle 34, and in the Table of Sines, for the diſtance of 100 *C. pts.* you will find 83 *C. pts.* for the Southing, and 56 *C. pts.* for the Weſting, and here becauſe the longitude and latitude doth both decreaſe, this muſt be ſubſtracted from the longitude and latitude of the former place; ſo your latitude of C will be 3 deg. 17 parts, and the longitude 3 deg. 44 parts.

Mark this well and it will direct you in any courſe whatſoever.

1 The latitude and longitude both decreaſe.

Now if you ſayl from this place C to D full South 100 *C. pts.* Here you need only ſubſtract this difference of latitude out of the former, ſo that the latitude of the place D is 2 deg. 17 parts, and the longitude the ſame as before, 3 deg. 44 parts.

2 Latitude decreaſeth longitude the ſame.



3 Latitude increaſeth, longitude decreaſeth.

But now if from hence you ſayl to E, which is *N W* 100 parts, find this angle 45 deg. in the Table, and you ſhall find for the Northing of the 100 parts, 71 parts, and for the Weſting 71 parts. In this Courſe you may ſee the latitude increaſeth, therefore that muſt be added, but the longitude decreaſeth, therefore that muſt be ſubſtracted: So the latitude of the place at E is 2 deg. 88 parts, and the longitude is 2 deg. 73 parts.

4 Longitude and latitude both decreaſe.

From hence to F both the latitude and longitude decreaſeth, ſo they muſt both be ſubſtracted as in the firſt Courſe.

5 Latitude decreaſeth, longitude increaſeth.

From F to G the latitude decreaſeth, therefore is ſubſtracted

ſtracted from the laſt latitude, but the longitude encreaſeth, and therefore is added to the longitude of the former place.

From G to H there is onely difference in longitude, which is to be ſubſtracted. From thence to I and K the latitude and longitude both decreaſe, and therefore are both ſubſtracted. And now being at K your latitude is 0 deg. 19 parts, and your longitude is 0 deg. 19 parts; ſo that you are within 27 *C. pts.* of the place A, which may be ſuppoſed for the place whither you intend your Voyage.

6 Longitude decreaſeth, latitude the ſame.

Thus theſe ſmall parcels of your reckoning, which are very troubleſome to ſet down upon your Map or Chart, with your Ruler and Compaſſes, and cannot be ſet down ſo neither with any exactneſſe or certainty, may thus be moſt readily and certainly caſt up, and ſo ſet down in any Map or blank Chart, either ſeverally, or once for many times, as you you will, obſerving their longitude and latitude; and ſo when you pleaſe you may make a prick or point in your Chart, and ſee whereabouts you are at any time, without any farther trouble yea, if you pleaſe, you may do this only by gueſſing with your eye whereabouts the place ſhould ſtand according to the longitude and latitude thereof.

Caution.

But in this way of reckoning your longitude and latitude, you muſt be under or neer the Equinoctial, where the degrees both of longitude and latitude are equal each to other. For elſe though you may reckon the true latitude of a place, yet you will fail much in the longitude thereof. Only thus much you may reckon upon in all places; that as you are ſo much, that is ſo many miles or leagues to the North or South of any place; ſo you are alſo ſo many miles or leagues, to the Eaſt or weſt of that place. Which how you ſhall reckon up into degrees of longitude, I ſhall ſhew you alſo in its place.

This way of plain ſayling is to be uſed onely in ſhort diſtances, or in places neer the Equinoctial, for though it ſhewes the true latitude, yet it is very unfit to ſhew the longitude, unleſſe it be neer the Equinoctial, where the deg. of longitude and latitude are both alike of equal length and breadth.

CHAP.

CHAP. IV.

Of Currents at Sea, how to find them out, and how to allow for them in your account.

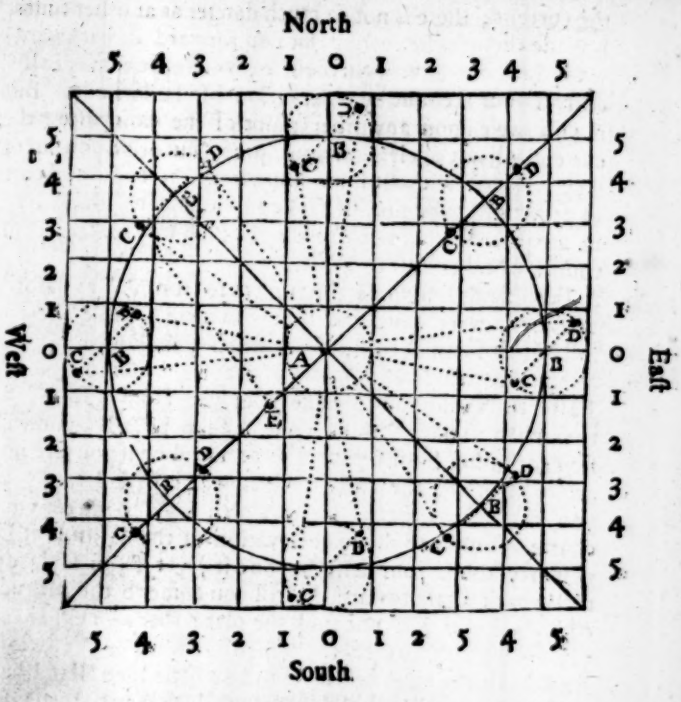
THis obſervation of Currents, though it be of great uſe, yet as there hath been little written thereof, ſo (the more is the pity) there is not ſuch regard and obſervation of it as there ought to be. For as the ignorance hereof, doth many times confound men, and make them at a loſſe in their accounts: ſo a true knowledg thereof would as much direct them, and further them in their voyages. And without the knowledge hereof in ſome ſort, you can keep no true account of your way, neither by your dead reckoning, nor by obſervation of latitude.

To make inſtance in that notable Current which is obſerved in the Weſtern Ocean to run toward the North Weſt.

In this Example look onely upon the *N. E.* line of the figure.

Suppoſe A to repreſent the *Summer Iſlands*, and the current thereabouts to run *N E* about 12 miles, or 20 *C. pts.* of a degree every day: If you were to ſayle with this current from A to B (*viz.* that B which lies full North Eaſt from the Center A) being from it about 5 degrees or 500 *C. pts.* every day that you ſayle thus with the current, the ſaid curent will ſet you forwarder then your account by 20 *C. pts.* So that though you think you ſayle but 1 deg. or 100 parts a day for 4 dayes time, and ſo reckon you are come but to C, which is 4 degrees, or 400 *C. pts.* of your way, yet the current in that 4 dayes time running 20 *C. pts.* each day, will ſet you forwarder 80 *C. pts.* So that you will be at, or neer your part B by a day ſooner, then you were aware of.

But



But now ſuppoſe you were to ſayle from B to A back again, or which is all one in effect, from A to that B which lies South Weſt, oppoſite to the former. Here now every day that you ſayle upon this courſe, the current will ſet you back 20 *C. pts.* So that though you ſayle according to your dead reckoning 100 *C. pts.* every day, for 3 dayes together, and ſo ſhould think your ſelfe to be at B, yet the current in that time will ſet you backward 5 times 20 *C. pts.*, ſo that you will have ſayled but 400 *C. pts.* and ſo are but at D, and want a full dayes ſayling to your place B.

In this Example look onely upon the *S. W.* line of the figure.

Bur

But when you thus ſayle either directly with, or againſt the current, there is not ſo much danger as at other times, becauſe though the current ſet you forward or backward; yet it doth not alter your courſe, and ſo you may eaſily correct your account by obſervation of the latitude. But if you ſayle upon any other point of the Compaſſe, the current will not only alter your ſpeed, but drive you out of way, ſo that without ſome knowledge hereof, and care to prevent it, you may in ſayling to ſome lone Iſland, be at ſuch a loſſe, that you know not which way to ſteer your courſe, whether Eaſt or Weſt.

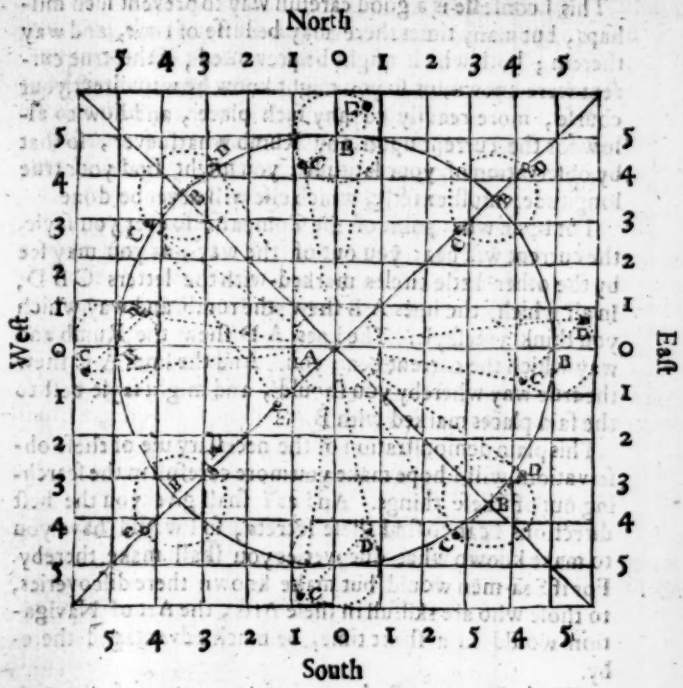
In this Example look upon the North line of the figure.

For Example ſuppoſe the current to run *N E* as before, 20 *C. pts.* every day, and that you were to ſayle therein full North from A to B. Here when you think you ſayle directly North from A to B, the current running North Eaſt, will cauſe you to make your way from A to D, ſo that when you ſhall think your ſelfe to be at B, you will find (or rather looſe) your ſelfe at D. For if you are not aware before of the current which way it hath driven you, you can by no means know which way to direct your courſe. For though by obſervation of the latitude at D, you may think your ſelfe beyond it; yet if you ſayle directly back again toward A, till you come to the latitude of B, yet you will not find the place there; neither can you tell which way it lies, whether Eaſtward or Weſtward. And this if the place you ſayle to be a little lone Iſland, you will be at a great loſſe, & not know which way to turn your ſelfe, as ſome have been in this caſe; And this I ſuppoſe hath been the ground and reaſon of thoſe ſtrange ſtories of floating and invisible Iſlands in the great Weſtern Ocean.

In this Example look upon the South line of the figure.

The like or rather the contrary will happen, if you were to ſayle South from B to A, or which is all one in effect from A to B, which lyes full South. Herein when you think your ſelfe at B, the current will drive you to D, and though you find your ſelfe ſhort in latitude, and ſo think to find the place B by ſayling ſtill South, yet you will fall beſides the the place, and not know which way to ſayle to

it



it, unleſſe you know whether the current hath driven you to the Eaſtward or Weſtward of the place you are bound to.

To prevent this loſſe it is uſual by thoſe who are carefull, not to ſail point blanck upon ſuch little Iſlands, but to be ſure get into the latitude of the place, a good way either to the Eaſtward or Weſtward thereof, as their way beſt lyes for it, and ſo being ſure which way the places lyes from them, to keep in that latitude, till they are in ſight of the place deſired.

This I confeſſe is a good carefull way to prevent ſuch miſhaps, but many times there may be loſſe of time, and way therein; both which might be prevented, if the true current were known; for ſo you might know how to direct your courſe, more readily to any ſuch place, and how to allow for the current upon any Rumb whatſoever, ſo that by obſervation of your latitude, you might find your true longitude, moſt exactly, which elſe will never be done.

For upon what point of the Compaſſe ſo ever you ſayle, the current will bear you out of the way, as you may ſee by the other little circles marked with the letters C B D, In all which, the lines A B ſhew the rumb and way which you think you ſayle. The lines A D ſhew the Rumb and way which the current bears you. And the lines A C ſhew the true way whereby you ſhould, and might ſayle beſt to the ſaid places marked with B.

This plain demonſtration of the neceſſary uſe of theſe obſervations, will I hope make you more carefull in the ſearching out of theſe things. And as I ſhall give you the beſt directions I can to find theſe ſecrets, ſo I would have you to make known what diſcoveries you ſhall make thereby. For if Sea-men would but make known there diſcoveries, to thoſe who are skilfull in theſe Arts, the Art of Navigation would in a ſhort time, be much advantaged thereby.

The beſt way to find out theſe currents, is by keeping exact account of your way both outward and homeward, according to your dead reckoning, being very curious in obſerving the way your ſhip makes by your log-line. For though you may correct your account for your better direction in your voyage, yet it is not your corrected account, but your dead reckoning that muſt help you herein. And therefore you muſt be very carefull of that, trying how the ſhip goes by it many times, when you have little or no need, as when you ſayle neer the Meridian. For hereby you ſhall be more perfect in this way of account, & finding how your ſhips way agrees with your line,

you

you may the better know how to uſe it and truſt to it, when you have more need thereof.

The manner of this work will be made more plain by two or three Examples then many directions.

Suppoſe you were to ſayle from A to that B, which lyes Northweſt from A, being about 5 degrees diſtant; and (either knowing or ſuſpecting the nature of the current,) you ſhould not ſayle the direct way Northweſt, but a point more to the Weſtward, *viz.* *N W by W*, to the diſtance of 5 deg. 15 *pts.* or 515 *C. pts.* in the ſpace of five dayes, and ſo whereas by your dead reckoning you ſhould be but at C, yet you ſhould arrive at your port B. And then when you return home again, you ſhould neither ſayle the direct way from B to A, which is South Eaſt; nor by the oppoſite point you came upon which is C A, and lyes *S E by E*, but ſhould continue your account as it were from C, and ſteer your courſe back again from C upon the third Rumb *S E by S*, as if you were to ſayle from C to E; and now having ſayled hereupon likewiſe 5 deg. 15 *C. pts.* in five dayes, you ſhould find your ſelfe to be returned to A. And now by this different reckoning you would know theſe three things. 1 Which way the current ſets? 2 How faſt it runs? 3 The true difference of latitude and longitude of theſe two places?

In ſayling in this current from A to B Northweſt, your account outward will be as if you were to ſayle from A to C, and your account homeward will be as if you were to ſayle from C to E; and yet by reaſon of the current you will come to the place A.

Firſt to this end make a Table of your account outward and homeward, according to the former rules.

From A to C	deg.	*C. pts.*	*N*	*S*	*E*	*W*
N W by W or	5	0	2.80			4.15
N W 56 deg.	0	15	08			12
5 deg. 15 *C. pts.*			2.88			4.27

From C to E	Deg.	*C pts.*	*N*	*S*	*E*	*W*
SW by S or	5	0		4.15	2.80	
SW 34 deg	0	15		12	8	
				4.27	2.88	

S	4	27
N	2	88
Reſt	1	39
W	4	27
E	2	88
Reſt	1	39

Now theſe two accounts being both contrary in each part, muſt be ſubſtracted from each other, *viz.* the North from the South, ſo there will remain South 1 deg. 39 *C. pts.* And the Eaſt from the Weſt, ſo there will remaine Weſt one degree, 39 *pts.* alſo. By which it appears that you have been forced to goe 1.39 *C. pts* Southward, and alſo 1.39 *C. pts.* Weſtward more then you need have done, for elſe the way outward and homeward would have ballanced the one with the other: where as now you ſee there is 200 *C. pts.* difference, for where as you are come back again to the place A, yet your accounts make as if you were at the place E, which is Southweſt from A 200 *C. pts.*

Now in the firſt place, to know which way the current runnes, you ſee that whereas by your accounts you ſhould be at E, which is Southweſt from A about 200 *C. pts.* yet you find your ſelfe to be at A, ſo that the current in this time hath driven you from E to A, which is Northweſt 200 *C. pts.* As farther appeares, if you compare the Southing of your account extraordinary, which you found before to be 1 deg. 39 *C. pts* with the Weſting thereof which was likewiſe 1 deg. 39 *C. pts.* ſo that the Southing and Weſting being equal, it muſt needs make an angle of 45 deg. and ſo run Northeaſt as I ſaid before. Now the Secant of this angle for 1 deg. 39 *C. pts.* will give 196 57 *C. pts.* which is almoſt 200 as I ſaid before.

By the 4 and 5 Caſe of plain Triangles.

Then in the ſecond place if you conſider the time, outward, which was 5 dayes, and home againe 5 dayes in all 10 dayes, and divide the foreſaid 200 by this, you ſhall find that every day the current runs 20 *C. pts.* which is 12 miles every day.

Then

Thirdly though there is much difference in the longitude and latitude of theſe two accounts outward and homeward, ſo that you cannot tell what is the difference of latitude and longitude between theſe two places, by any one of them: yet if you adde theſe two accounts together, and then take the halfe of them, you ſhall have the true difference of longitude and latitude of theſe two places A and B.

Thus your account outward *Nor.* 2 d. 88 *pts.* *Weſt* 4 d. 27 *pts*
and your account homeward *Sou.* 4 27 *Eaſt* 2 88

The Summe of theſe two are	7	15	7	15
The half, ſhews the true dif. of lat.	3	$57\frac{1}{2}$ & lon.	3	$57\frac{1}{2}$

And hereby alſo it appears that the true Rumb between the two places is Northweſt.

To make this more plain, take another example. Suppoſe you were to ſayle from A to that B which lyes full North, having five degrees difference of latitude, but under the ſame meridian; and that you ſhould ſayle thither upon ſeveral points of the Compaſſe, in ſix dayes time as in the following Table.

	Courſe.	Diſtã.	North	South	Eaſt	Weſt
The firſt day.	*N W*	100	71			71
The 2 day.	*N W by N*	100	83			56
The 3 day.	*N N W*	100	92			38
The 4 day.	*N by W*	100	98			19
The 5 day.	*N E*	100	71		71	1. 84
The 6 day.	*East*	30	00		30	Reſt
			4. 15		1. 01	0. 83
Current.	*NE*	120	85		85	
			5. 00		R. 02	

By

By this you reckon the place B, to be 4 deg. 15 *C. pts.* to the Northward and 1 deg. 83 *pts.* to the West, the Easting being substracted.

Now suppose you should sayle back again to the place A in 6 dayes and an halfe, as in the following Table.

	Course.	Distā.	North	South	East	West
The first day.	*S W*	100		71		71
The 2 day.	*S W by S*	100		83		56
The 3 day.	*South*	100		1. 00		00
The 4 day.	*South*	100		1. 00		00
The 5 day.	*South*	100		1. 00		00
The 6 day.	*South*	100		1. 00		00
The ½ day	*S E*	50		35		1. 27
				5. 89	35	3. 35
						R. 92
Current for 6 dayes ½.	*N E*	130	Su. 92		92	Rest
			Rest	4. 97	Subst.	00. 0

By this it should seem that the place A is to the Southward from B, 5 deg. 89 *C. pts.* and Westward 0 deg. 92 which doth much differ from the account outwards. Now to reconcile them; and to find the current, which way it sets, and how fast it runs.

North	4	15
South	5	89
Rest	1	74
West	0	83
West	0	92
Sum	1	75

First compare the two accounts together, and substract the North from the South; but adde both the Westings together, because they are of one sort: so you will find the current hath caused you to goe out of your way to the Southward 1 deg. 74 *pts.* and to the West 1 deg. 75 *pts.* which Southing and Westing being equal, the current must needs run Northwest.

Secondly by the fourth and fifth case of plain Triangles having the two sides of the Triangle, the Secant thereof or the distance which the current hath run in this time will be 247 parts, which divided by the time 6 dayes outward,

ward, and 6 dayes and an halfe homeward, in all 12 dayes and an halfe, gives about 20 parts for each day, and 7 parts for the halfe day: so that you may conclude the current runs 20 *C. pts.* which is 12 miles a day.

Lastly for the true difference of longitude and latitude of these two places; Adde the summes of the North and South columnes together, they make 10 degrees, or little more, the halfe whereof is 5 deg. which is the difference of latitude. For the difference of longitude, because both wayes it falls out to be Westerly; you must not adde them but substract the one from the other, and the halfe of the remainer will be 4 *C. pts.* which shewes these two places differ little or nothing in longitude.

N	4 15
S	5 89
	10 04
½	5 02
W	0 83
W	0 92
	0 09
	0 04

By this which hath been said, I hope you will be instructed not only how to find these currents, but how to use them. The best way for you, will be to keep two severall accounts, the one of which you may correct according to your observation, the other keep only by the Log line. And if you find any time that your observations, do differ more then the ordinary, from your dead reckoning; you may well think there is some current which drives you out of the way.

To conclude this point when you know how fast any current runs, and which way, it will be good to set down in your account, some * allowance for it, every day, or at least every three or four dayes, so your accounts will better agree, and be most exact both for longitude and latitude. Thus in your account outward, allowing for the current *N E* 20 parts a day, for the six dayes 120 parts. This by the Tables yields 85 parts for the Northing, and 85 parts, for the Easting, which Northing added to the former, make the difference of latitude 5 deg. and the Easting substracted from the Westing, there remains for the difference of longitude, only 2 parts, which is little or nothing in these accounts.

* The way how to do this is expressed at the bottome of the former accounts.

Likwise in the account homewards for the current *N E* 130 parts for the 6 dayes and an halfe, this yields for the

the Northing 92 parts, and for the Eaſting 92 parts; which 92 parts Northing, ſubſtracted from the Southing 5 deg. 89 parts reſt for the difference of latitude 4 deg. 97 parts. Likewiſe the Eaſting ſubſtracted from the Northing, reſt for the difference of longitude juſt 0. And thus you have the true difference of longitude and latitude of theſe courſes and diſtances, as at firſt propounded, without any ſenſible difference in theſe accounts.

CHAP. VI.

How to make a true Chart for any part of the World.

ALl that I have hitherto ſpoken concerning ſayling, is chiefly (if not only) meant of your ſayling by the plain Chart; concerning which I might adde many other Propoſitions, which I ſhall referre to another place. But you muſt know that moſt of theſe Propoſitions, will not be truly performed, (eſpecially in reſpect of longitude) unleſſe you are in places nigh the Equinoctial, where the degrees of longitude, and latitude are both equal. And therefore our Country-man Mr. *Ed. Wright* invented (although *Mercator* a forreigner almoſt got the name and praiſe thereof) a very excellent Sea-Chart, which performs the like concluſions, and almoſt in the like manner, and with as much readineſſe, as the plain Chart doth; but with farre more truth, in all places, which have any latitude. The making and uſe of this Table, is now generally as well known as the Plain Chart, and therefore I ſhall not ſpend much time to inſtruct you in the making thereof, but rather ſhew you how theſe Tables may help you in the uſe thereof.

Yet becauſe theſe Tables may ſomewhat help you in the making of theſe Charts, when you want a Table or a Scale of the Meridian line, you may ſoon make one by theſe

theſe Tables of Secants, beginning at any latitude you will.

D.	*Secãt*	*Merid.*
50	000	000
51	159	156
52	162	321
53	166	487
54	170	657
55	174	831
56	179	1010
57	184	1194
58	189	1383
59	194	1577
60	200	1777

Theſe Tables are made by the addition of Secants, ſo that take what degree of latitude you pleaſe to begin at, as here this Table begins at 50 degrees, let that be your Radius, then look the Secant of 51 deg. in the laſt line of the leafe, where you ſhall find 158.90 (but omitting the 2 laſt figures, reckon 159) and ſet this againſt 51 deg: & then look out the Secant of 52 deg. which is 162, and adde this to 159, it makes 321, and ſet this in the next column, and ſo for the reſt of the degrees, as many as you deſire. Thus you ſhall have the true proportion of theſe whole degrees of latitude of this Chart, to the equal degrees of longitude, as exactly as you need deſire.

As for the minutes, or Centeſmes of theſe degrees, (though it will be ſufficient to divide each degree into ten parts) theſe you ſhall have exactly caſt up to your hand in the Tables, ſo that you need but turn to the degree you would divide, and there the parts thereof are ſet down to your hand. As if you would divide the 51 deg. which is between 50, and 51. Turn to the Secant of 51 deg. and there you ſhall find the ſeveral parts thereof ready caſt up in this Table.

D.	*pts.*	*pts.*
50	10	16
	20	32
	30	48
	40	64
	50	79
	60	95
	70	111
	80	126
	90	143
51.	00	159

Thus by a larger Decimal Scale you may lay down the whole degrees of your Chart, and then by laying a leſſer Decimal Scale; to the beginning of each degree, you may divide your Meridian very neatly, and with much eaſe.

But this will be more exact, eſpecially in places which have great latitude; if you make your Table for every halfe degree, and ſo take out the halfe Secants, or the Secants of 50 *pts.* ſetting them halfe a degree forwarder then they ſhould be. Thus in this Table, beginning at 50 degrees, which is the Radius ſet down 00 ſecant, 00 Meridian, then for 50 d. 50 *pts.* take halfe of the Secant of 50 deg. which you ſhall find at the bottome of the leafe, againſt 50 in the margent, which is 78, being halfe of the whole Secant 156, and ſet this down againſt 50 d. 50 *pts.* as you ſee in this Table. Then for 51 deg. take the halfe Secant, or the Secant of 50 *pts.* which is 79, and adde this to the foreſaid 78, it makes 157. Likewiſe for 51 d. 50 take the halfe Secant of 51 d. again, which is 79, and adde it to the former, it makes 236, and ſo ſtill uſe the halfe Secant twice; as you may ſee more by the Table.

D. pts.	*Secã.*	*Merid.*
50. 00	00	00
50. 50	78	78
51. 00	79	157
51. 50	79	236
52. 00	81	317
52. 50	81	398
53. 00	83	481
53. 50	83	564
54. 00	85	649
54. 50	85	734
55. 00	87	821
55. 50	87	908
56. 00	89	997
56. 50	89	1086
57. 00	92	1178
57. 50	92	1270
58. 00	94	1364
58. 50	94	1458
59. 00	97	1555
59. 50	97	1652
60. 00	100	52

And thus at laſt there growes ſome difference between theſe two Tables, though but little in every degree, which by that time it comes to 60 degrees, is ſomewhat conſiderable, the firſt making the meridian 1777 *pts.* and this but 1752, which is much the truer, the true parts by Mr. *Gunters* meridian line being 1755. The degrees being thus ſet upon your Charr, you may divide them into minutes tenths, or 100 *pts.* as before.

If

If you have any further need of the meridian line, either for the making of your Charts, or the caſting up of your account thereby, to try how it agrees with theſe following Rules, you ſhall have a full and plain table thereof at the end of the other Tables.

According to theſe Rules and Tables having made your your Chart, they will be a good helpe unto you in the keeping of your account, ſhewing you ſtill whereabouts you are, and which way you muſt ſteer your courſe, and when to adde or ſubſtract your latitude or longitude, as the plain table did before, being all one in effect, only the degrees of latitude are inlarged, according to the proportion of the longitude.

The excellent uſe of theſe Tables of Secants never thus applyed by any man before.

And here obſerve though I made ſome uſe of the table of Secants before, yet now I am to ſhew you a far more excellent uſe thereof; which indeed was my chief intent and purpoſe, in this preſent treatiſe. For here you ſhall ſee by theſe tables of Secants, all the problemes of Navigation, performed upon *Mercators* Chart, as before they were performed upon the plain Chart, without any calculation; having ſtill your numbers ready caſt up for you in theſe Tables.

As this is that which hath been hitherto wanting, ſo I hope, being ſo new and excellent a way it will be both welcome, and profitable to you; Mr. *Norwood* in his *Seamans Practice*, hath well explained and applyed the firſt part of theſe tables, *viz.* the Table of the Sines: but yet he makes no uſe, nor mention, either of the Tangents or Secants; not ſo much as in the plain Table account, in which you ſee they are of good uſe, and many propoſitions therein, cannot well be reſolved without them. But for the applying of them to this Chart, I think neither he nor any other ever yet thought of it. But herein you ſhall find them of moſt excellent uſe, far beyond the Meridian line ordinarily practiſed, which cannot be uſed without calculation. But as all things that are new and unknown may ſeem a little hard and difficult at the firſt, ſo

perhaps the manner of working theſe concluſions, may ſeem at firſt unto you. But thus much you ſhall find, that thoſe which are moſt neceſſrry, are the moſt eaſie, both for your learning, and for your uſe; and therefore to encourage you the better, I ſhall begin with them.

Propoſition 1.

By the Rumb and the Diſtance ſayled upon the Rumb, to find the true latitude and longitude, according to the true Sea Chart, in any latitude.

This I know you will grant is the moſt uſual, if not the moſt neceſſary propoſition in the practice of Navigation; being the manner of keeping your accounts at Sea, which you call your dead-reckoning. And the performing of this by theſe Tables of Secants, is ſo plain and eaſie, that I have little more to ſay to it, then what I have ſaid already in the former Chapters, concerning the way of keeping this account upon the Plain Chart.

Firſt, you muſt make the like Table, and uſe the ſame way which you did before, to find out the Eaſting and Weſting, the Northing and Southing of your Rumb; which you muſt ſet down likewiſe in your Table, juſt as you did before.

Secondly, likewiſe by addition or ſubſtraction of the Northing and Southing, you ſhall find the true latitude of the ſeveral places, as you did before; But as for the longitude, as I told you then, the Eaſting and Weſting in your Table, will not ſhew the true longitude of thoſe places, unleſſe you be neer the Equinoctial, where the degrees of longitude and latitude are both of equal length and breadth unto each other.

Therefore in the third place, before you come to turn your Eaſting and Weſting into longitude, make another column in your Table, which you may call the Secant columne, in which you ſhall ſet down your Eaſting and Weſting,

Weſting, as it ought to be inlarged, in the number of deg. or parts of degrees, according to that degrees latitude which you are in at the preſent time; And this inlargement of the Eaſting and Weſting, is the work which I ſhall now moſt plainly and readily ſhew you how to find it out, by theſe Tables of Secants; the manner whereof is briefly thus.

Obſerve the degree of latitude in which you have made your couſe; (which you ſhall alwayes find ready in your Table, if you ſumme up your column of latitude, as you ought to doe,) and turn to the ſaid degree in theſe Tables, and in that leafe, look down the margent, for the number of your Eaſting or Weſting, which you have ſet down already in your Tables, and againſt it in the ſame line, under the column of Secants, you ſhall have the true parts of your longitude, inlarged as they ought to be. Which being ſet down in your Table of account, in the column of Secants, they may be afterward added or ſubſtracted, as the Eaſting or Weſting of the longitude requires, and ſo ſet down as you ſee them in the column of longitude, by this meanes your Table of account ſhall be made very true and perfect, ſhewing you the true longitude and latitude of the place where you are at any time, which you may prick down upon any Chart, Map, or Globe, and ſo know exactly where you are, and which way to ſhape your courſe, to what ever place you intend to goe.

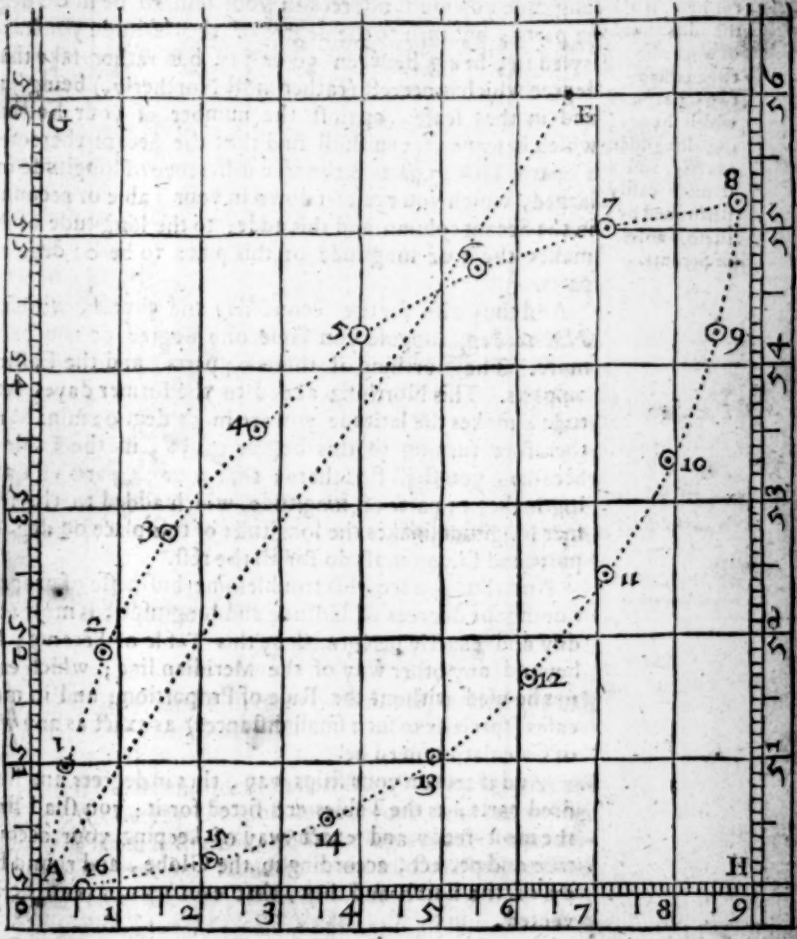
This

This Table of account and the following Chart, will make all as plain as may be.

The places.	The Course.	distã. D pts	Nor. D pt	Sou. D pts	East west. D pt.	D pts	Lat. D pt	Secã. D pts	Long D pts.
From A.	d.						50,00		00,00
from A to 1	*N E* 10	1,00	98		17		50,98	0,27	00,27
from 1 to 2	*N E* 20	1,00	94		34		51,9[illegible]	0,55	00,82
from 2 to 3	*N E* 30	1,00	87		50		52,79	0,81	01,62
from 3 to 4	*N E* 40	1,00	76		64		53,55	1,06	02,[illegible]
from 4 to 5	*N E* 50	1,00	64		76		54,19	1,29	03,97
from 5 to 6	*N E* 60	1,00	50		78		54,69	1,48	05,45
from 6 to 7	*N E* 70	1,00	34		94		55,03	1,64	07,09
from 7 to 8	*N E* 80	1,00	17		98		55,20	1,71	08,80
from 8 to 9	*S W* 10	1,00		98		17	54,22	29	08,51
from 9 to 10	*S W* 20	1,00		94		34	53,28	56	07,95
frõ 10 to 11	*S W* 30	1,00		87		50	52,42	81	07,14
frõ 11 to 12	*S W* 40	1,00		76		64	51,65	1,04	06,10
frõ 12 to 13	*S W* 50	1,00		64		76	51,01	1,21	04,89
frõ 13 to 14	*S W* 60	1,00		50		87	50,51	1,35	03,54
frõ 14 to 15	*S W* 70	1,00		34		94	50,17	1,46	02,08
frõ 15 to 16	*S W* 80	1,00		17		98	50,00	1,52	00,56
fro. 16 to A.		0,36				56	50,00	0,56	00,00

In this Table and Chart you may see that the Port you sayle from is supposed to be at A, having 50 deg. of latitude, and 00 degrees of longitude; and from hence suppose that the first day you sayle North Easterly, upon an angle of 10 deg. which is almost North by East, to the distance of one degree, or 100 parts, and you find by the Table of Sines (as before) that the Northing of this course and distance is 98 *C. pts*: and the Easting thereof is 17 *C. pts.* which must be set under the columns of North and East. Now this Northing, added to the foresaid lati-

A Figure of the true Sea-Chart.



latitude of the place A, which was 50 deg. makes the latitude of the place you are in 50 deg. 98 parts, or almoſt 52 deg. as the column of latitude ſhews. * But now for the longitude you muſt not reckon your ſelfe to be in 00 deg. 17 parts; but turn to the degree of the latitude you have ſayled in, being between 50 or 51, but rather take that degree which is neereſt (rather moſt Northerly,) being 51, and in that leafe, againſt the number of your Eaſting which is 17 parts, you ſhall find that the Secant thereof is 27 parts. This 27 parts is the true difference of longitude inlarged, which you muſt ſet down in your Table of account, in the Secant column and this adde; to the longitude of A, makes the true longitude of this place to be 00 deg. 27 parts.

Note this well, for here is all the difference of worke betweene theſe two Charts, which ſhewes the longitude exactly, and is moſt eaſily performed by theſe Tables of Secants.

And thus alſo for the ſecond day and courſe, which is *NE* 20 deg. ſuppoſe you ſayle one degree or 100 parts more. The Northing of this is 94 parts, and the Eaſting 34 parts. This Northing added to the former dayes latitude, makes the latitude you are in 51 deg. 92 min. And therefore turning to this degree of 52, in the Table of Secants, you ſhall find there, that your 34 parts of Eaſting, makes 55 parts of longitude, which added to the former longitude, makes the longitude of this place 00 deg. 82 parts, and ſo you muſt do for all the reſt.

And thus you ſee this troubleſome buſineſſe of proportioning the degrees of latitude and longitude, is moſt readily and exactly performed by this Table of Secants; far beyond any other way of the Meridian line; which cannot be uſed without the Rule of Proportion; and in moſt caſes (ſpecially in ſuch ſmall diſtances) as exact as any way of Calculation need be.

And if reckon your ſhips way, thus in degrees and hundred parts, as the Tables are fitted for it; you ſhall have the moſt ready and exact way of keeping your account true and perfect, according to the Globe, and round body of the Earth and Sea, that ever was, as can be invented.

Prop-

This Table of account and the following Chart, will make all as plain as may be.

The places.	The Courſe	diſtã. D.pts	Nor. D.pt	Sou. D..pt	East D.pt.	weſt. D.ps.	Lat. D. pt.	Secãt D.pt.	Long. D pts.
From A.	d.						50,00		00,00
from A to 1	NE 10	1,00	98		17		50,98	0, 27	00, 27
from 1 to 2	NE 20	1,00	94		34		51,92	0,55	00, 82
from 2 to 3	NE 30	1,00	87		50		52.79	0,81	01, 62
from 3 to 4	NE 40	1,00	76		64		53,55	1, 06	02, 68
from 4 to 5	NE 50	1,00	64		76		54,19	1, 29	03, 97
from 5 to 6	NE 60	1,00	50		78		54,69	1, 48	05, 45
from 6 to 7	NE 70	1,00	34		94		55,03	1. 64	07, 09
from 7 to 8	NE 80	1,00	17		98		55,20	1, 71	8, 80
from 8 to 9	SW 10	1,00		98		17	54,22	29	08, 51
from 9 to 10	SW 20	1,00		94		34	53,28	56	07, 95
frõ 10 to 11	SW 30	1,00		87		50	52,42	81	07, 14
frõ 11 to 12	SW 40	1,00		76		64	51,65	1, 04	6, 10
frõ 12 to 13	SW 50	1,00		64		76	51,01	1, 21	04, 89
frõ 13 to 14	SW 60	1,00		50		87	50,51	1, 35	03, 54
frõ 14 to 15	SW 70	1,00		34		94	50,17	1, 46	02, 08
frõ 15 to 16	SW 80	1,00		17		98	50,00	1, 52	00, 56
fro. 16 to A.		0, 36				56	50,00	0, 56	00, 00

Propoſition 2.

By the Courſe, and difference of latitude, to find the true difference of longitude.

This is the ſecond queſtion neceſſary in keeping your account; for hereby you muſt correct your dead reckoning, when the latitude thereof, doth not agree with your latitude by obſervation. And herein as I told you before there are two caſes, the one, when you have ſayled only upon

one Rumb: the other when you have ſayled upon two or more ſeveral Rumbs.

If your correction be in reſpect of one Rumb; Marke what Rumb it is you have ſayled upon, and turn to the degree thereof in the Tables, then look down the margent of that leafe, and there find the difference of latitude which is between your dead reckoning and obſervation, and in that line in the Table of Tangents, you ſhall have the Eaſting or Weſting belonging to the ſaid difference of latitude upon that Rumb, as before in the uſe of the Plain Chart.

Let this difference of latitude, be added or ſubſtracted to the Northing or Southing in your Table of account as the occaſion requires; Likewiſe let the Eaſting or Weſting, be added or ſubſtracted to the Eaſting or Weſting of your account: your Northing being thus corrected, and ſet into the column of latitude, ſhall without any farther trouble, ſhew you the true latitude of the place you are in; But your Eaſting or Weſting muſt be firſt inlarged, according to the latitude you are in, by the rules of the former Propoſition, and ſo ſhall ſhew you the true longitude, being added or ſubſtracted to the longitude of the former account, as you muſt caſt it up all along your voyage.

For example, ſuppoſe you ſayle from A whoſe latitude is 50 deg. and longitude 20 deg. upon the third rumb, or angle of 34 deg. toward the *N E*, according to your dead reckoning about the diſtance of one degree or 100 parts, which is at the point B; your latitude and longitude will be according to your account by theſe foreſaid rules, latitude 50 degrees, 83 parts, longitude 20 deg. 87 parts, as in this Table.

The

	Diſt.	*North*	*Eaſt*	*Latit.*	*Secan.*	*Longit.*
The place A				50 00		20 00
NE 34 d.	100	83	56	50 83	0 87	20 87
	21	17	11	51 00	0 17	21 04

Now ſuppoſe that making a fair obſervation of the latitude, you find your ſelfe to be juſt in 51 deg. whereas by your account you thought your ſelfe to be but 50 deg 83 parts, here is a difference of 17 parts of latitude. And as you are gone further in latitude, ſo you muſt go further in longitude alſo then your account ſhewes for, which you deſire to know exactly. Firſt, therefore you muſt correct your Northing and Eaſting, by the Tangent of the angle of the Rumb for 34 degrees, which will allow for the 17 parts of latitude 11.47 parts of Eaſting: So you muſt ſet in your Table of account 17 parts under the North column, and 11 parts under the Eaſt column. This 17 parts of Northing added to your former latitude 50 deg. 83 parts, makes it juſt 51 deg. of latitude. Now to find the longitude belonging to theſe 11 parts of Eaſting, you ſee you are come to 51 deg. of latitude, turn therefore to 51 degrees in your Tables, and there againſt 11 in the margent, you ſhall find the Secant to be 17.48, for which you may ſet down only 17 in the Secant column, and this added to the former longitude, which was 20 d. 87 parts, makes it 21 deg. 04 parts, and this is the true longitude of the place you are in

Alſo the Secant of this angle 34 deg. ſhews the diſtance runne, which is 21 *pts. fere.*

This I account the beſt way of correcting your accoun, working onely by the difference of latitude which you find between your dead reckoning and obſervation; and not by the whole difference of latitude which you have ſayled, eſpecial if it be any thing a great diſtance exceeding 4 or 5 degrees: For in this caſe, in regard every degree of latitude doth alter ſomewhat from another, it will be more

trouble becauſe you muſt work by the middle latitude, and that ſometimes will not be ſo exactly performed as you may by your Ruler upon a Chart that is truly made and handſomely delineated.

And therefore now I come to this ſecond caſe, wherein you may be ſuppnſed to have made a farther progreſſe in your voyage, and have ſayled upon ſeveral Rumbs, and not have opportunity to make obſervation of the latitude before, and now find ſome difference between your account, and obſervation of the latitude; In this caſe as I told you before in the uſe of the plain Chart, ſo here alſo by the difference of longitude and latitude you muſt find the Rumb between this firſt and laſt place of your account. This you may do by theſe Tables as I ſhall ſhew you in the next Propoſition; but it will be better to ſave the labour, and only to draw a line in your Chart between the two places, and to find the angle of the Rumb between them with your Compaſſes: which you may do as exactly (yea p rhaps more exactly when the diſtance is any thing great) as you can by theſe or any other Tables of Meridianal parts, I am ſure far more readily.

The reaſon of this finding the Rumb between the two places I ſhewed before, * therefore I ſhall not here repeat it, though it be many times of much concernment in your account, and therefore not to be neglected, eſpecially when you are forced to any great alteration of your Rumb.

* In the third Propoſition of Plain ſayling.

Having found the Rumb between the two places, work by this angle, and the difference of latitude between your account and obſervation; finding firſt the Eaſting or Weſting belonging to that difference of latitude; and then by the parts of Eaſting or Weſting, find the inlargement of them, according to the latitude you are in, as I ſhewed before by the Table of Secants, Thus this difference of latitude being added or ſubſtracted to your account of latitude, and this difference of longitude being

like-

likewiſe added or ſubſtracted, to your account of longitude you ſhall have the true latitude and longitude of the place you are in. Provided that you are not driven out of your way by ſome unknown currents; as I ſhewed at large before.

An example of this I count needleſſe, being in effect the ſame as before; when you have once found the Rumb between the two places.

And thus theſe two Propoſitions, 1. How to keep your account both of longitude and latitude? 2 How to correct your account both in longitude and latitude? being the moſt uſefull and neceſſary Propoſitions in Navigation, are moſt eaſily and readily perfoimed by this Table of Secants in all latitudes whatſoever, without any calculation with the meridian line, which requires more trouble and labour, firſt in finding the parts of the meridian between the two latitudes; and then when you have found them, you muſt reſolve your queſtion by the Rule of Proportion.

Propoſition 3.

How to allow fot currents in your accounts.

By what I ſaid before concerning currents, it is manifeſt that for the moſt part they drive the ſhip out of the courſe you reckon upon both in reſpect of longitude, and latitude, therefore if they be known (by ſome former obſervation or other meanes) which way, and how faſt they run; it will be very good to allow for them in your account, which will be much more perfect thereby.

This allowance may be inſerted into your account either every day, or once in three or four dayes, according to the Northing and Southing, Eaſting and Weſting thereof, as I ſhewed before in the Chapter of Currents; which Northing and Southing, ſhewes the latitude in all places,

places, without farther trouble; But for the Eaſting or Weſting you muſt make an inlargement thereof, according to the latitude you are in, as I ſhewed in the laſt Propoſition, if your difference of latitude be not much, which will be when you make this allowance every day; or ſayle upon a courſe neer the Eaſt or Weſt. But if you let your account run for three or four dayes, without allowance, ſo that your difference of latitude be 4 or 5 degrees or more, then you muſt make your enlargement of the longitude, according to the former rules by the Table of Secants, but you muſt not worke by the latitude you are come to, but by the middle latitude between the two places, for ſo your longitude ſhall be more exact, as you ſhall ſee more, in the next Propoſition.

Thus if you were to ſayle from Cape *Race* or ſome part of New found land, having latitude 50 deg. and longitude 330 deg. the current running 20 *C. pts.* Northeaſt every day, you may frame your account thus allowing for the current (as it is beſt) every day, or upon every alteration of your courſe.

	Courſe	*Diſt.*	*North*	*South*	*Eaſt*	*Weſt*	*Latit.*	*Secãt*	*Longit.*
New found land	d.						50 0		330 0
The firſt day	*NE* 10	100	98		17				
Current.	*NE* 45	20	14		14				
			1, 12		31		51 12	49	330 49
The 2 day	*NE* 20	100	94		34				
Current	*NE* 45	20	14		14				
			1, 08		48		52 20	78	331 06
The 3 day	*NE* 30	100	87		50		53 07	83	332 09
The 4 day	*NE* 45	100	76		64		53 83	109	333 18
The 5 day	*NE* 50	100	64		76		54 47	129	334 47
Current									
for theſe 3 days	*NE* 45	60	42		42		54 89	71	335 18

By this Table you may ſee plainly how to allow for the motion of the current in any latitude, either every day, or once in three or four dayes; and by comparing this with the former, you may ſee what difference ſuch a current may make in your courſe in a little time; for whereas by that Table, in five dayes time you ſhould be in 54 deg. 19 parts of latitude, and 3 deg. 97 parts of longitude, which is at F upon the Map; By this Table you ſee you are come to 54 deg. 90 parts of latitude, and 5 deg. 18 parts of longitude, which is at D upon the Map. So that the difference of latitude is 69 parts, and the difference of longitude is 1 deg. 21 parts, in the ſaid five dayes time. So that this is a thing very conſiderable and good uſe may be made thereof, if the true courſe, and ſwiftneſſe of currents were known, and therefore as they are by all by care-diligent comparing of your courſe outward and homeward indeavoured to be found out; ſo being found I could wiſh they were made more publique, for the general good.

This Table is in effect all one with the former, onely the degrees of longitude are changed, but the difference of longitude would be the ſame, were it not for the ſuppoſed current.

Propoſition 4.

By the knowledge of the latitude, and longitude of two places, to find the Rumb, and alſo the diſtance between them, upon the ſaid Rumb.

This Propoſition admits of three ſeveral caſes.

This firſt is when both places have one and the ſame Meridian, and difference only in Latitude.

The ſecond is when the two places have one and the ſame latitude, and differ only in the longitude of their Meridians.

The third caſe is when the two places differ both in Latitude and Longitude.

And each of theſe caſes may have two or three varieties. *viz.* 1. One or both places being under the Equinoctial. 2. One or both places being to the North or South of the Equinoctial. 3. One place being to the North, and the other

other to the South of the Equinoctial.

But theſe varieties many of them are not ſo proper to be reſolved by this Chart, as by the Doctrine of Spherical triangles, here we ſhall only ſpeak of places which have no great diſtance, they being beſt reſolved by theſe rules.

For the firſt of theſe Caſes, If two places have one and the ſame Meridian, and differ only in latitude: then the Rumb between them, muſt needs be North, and South, and the difference of latitude, is the true diſtance between the two places, let them be in what latitude they will. For though the degrees of latitude in the Chart do ſeem to encreaſe, and grow longer toward the Poles; yet they are all of one length, *viz.* about 20 leagues, or 60 miles and that inlargement of them in the Chart, is onely in reſpect of the degrees of longitude; which though they ſeem (on the contrary) to be all of equal breadth, yet grow leſſe and leſſe toward the Poles, one deg. in the latitude of 60 deg. being but 10 leagues or 30 miles, which is but halfe a degree in the Equinoctial.

So that let the one place be A in the latitude of fifty degrees, and the other in the latitude of 55 deg. under one and the ſame Meridian, or line of longitude; the courſe between them is North, and South, and the diſtance is 5 degrees, according to the difference of latitude between them: which makes 100 leagues, or 300 miles.

For the ſecond caſe, when both places have one and the ſame latitude, but differ only in longitude; then the Rumb between them muſt needs be Eaſt and Weſt: But the diſtance is not according to the degrees of longitude (as before) but beares a proportion to the Coſine of the latitude.

So that as the Radius;
To the Coſine of the latitude.
So their difference of longitude in degrees and parts,
To their diſtance in degrees and parts.

This

This may beſt be found out upon the Chart thus, Open your Compaſſes to halfe the diſtance between the two places, and ſetting one foot of your Compaſſes in the common latitude of the two places. Mark how far the other foot will reach both above and below it, upon the Meridian line, and the degrees of latitude between theſe two points, will be the diſtance (or very neer) between the two places.

But this may be far more eaſily performed by theſe Tables, as thus; Firſt, turn to the degree of latitude which the two places are in, and find in the margent the degrees of the difference of longitude between the two places, and in that line in the Table of Sines, under the ſaid latitude of the places, you ſhall have the true diſtance in degrees and parts.

Thus let the two places be A and H, both in the latitude of 50 degrees, and let their difference of longitude be 9 deg. Turn to 50 deg. in the Tables, and againſt 9 in the margent, under the ſine of 50 deg. you ſhall have 5.79, which ſhewes the diſtance between the two places is 5 deg 79 parts, which is 116 leagues *fere*, or 347½ miles *fere*.

Or elſe let the two places be G and E, both in the latitude of 56, and their difference of longitude 6 deg. 75 parts. Turn to 56 degrees in the Tables, and under the ſine of 56 deg. you ſhall find thus;

For ſix degrees of longitude	3 deg.	36 parts.
For 75 parts of longitude	0	42
Which added, ſhews their diſtance	3	78

Which makes 76 leagues or 227 miles *fere*.

The third caſe is when both the places differ both in longitude and latitude.

This is the moſt uſual caſe, but yet let me tell you, that this queſtion may with more eaſe, and as much exactneſſe, be reſolved upon your Chart with your Ruler and Compaſſes, as

as by theſe or any other Tables of Meridional parts: eſpecially when the diſtance is any thing large, I mean about 4 or 5 degrees. And therefore I ſhall rather adviſe you, to uſe that way, and to follow the rules to this purpoſe, in my *Geometrical Sea-man*, eſpecially in finding the Rumb between the two places, which as it may moſt readily be found out thereby, ſo if you have any care, you may find the Rumb as exactly as you need or can ſteer your courſe to any place.

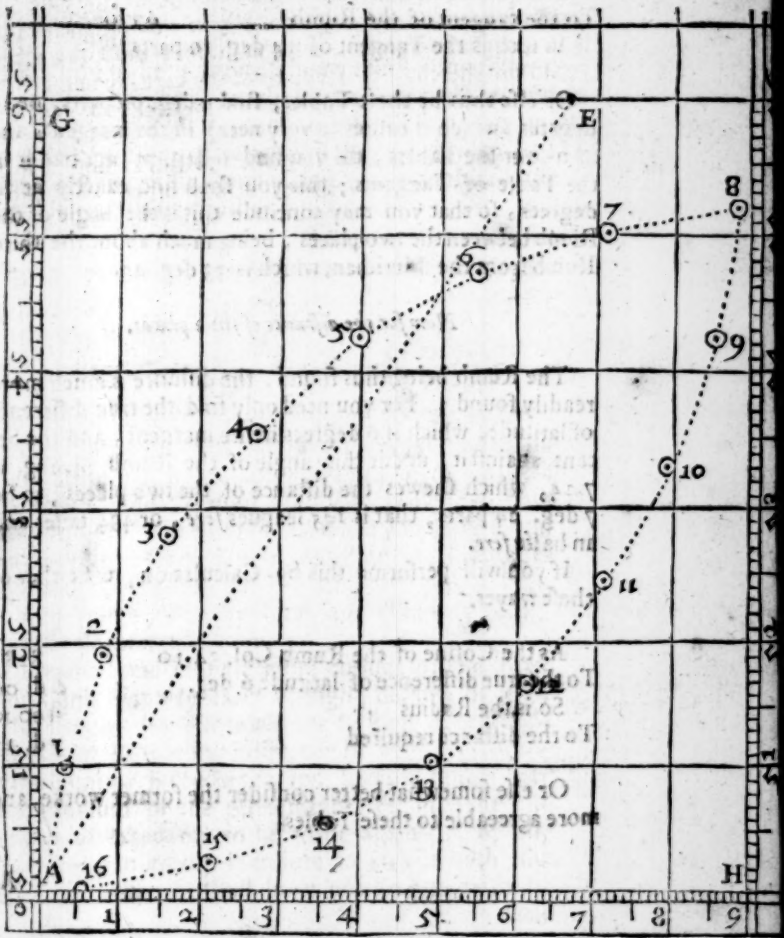
But that you may ſee here is no defect in theſe Tables, in this particular, more then in any other, the way of worke is thus, which is ready enough being well underſtood, and a little practiſed.

Suppoſe the two places to be A and E, A in the latitude of 50 deg. and E in the latitude of 56 deg. and the difference of longitude between them is ſix degrees, 75 parts. Now it is deſired to know the Rumb, and the diſtance between thoſe two places.

Firſt for the Rumb.

Firſt, conſider the ſeveral latitudes of the two places, which is 50 deg. and 56 deg. and take the middle latitude between theſe 2, which is 53 deg. Turn to this degree in the Table, and there find the true difference of latitude in the margent, which is 6 degrees, and againſt it in the Table of Secants, you ſhall find 9.97, that is 9 deg. 97 parts, for the difference of latitude inlarged, which you ſhall find much as one with your Meridional parts in Mr. *Gunters* Table, which are 9 deg. 99 parts which makes the degrees of latitude proportionable to the degrees of longitude, and with this latitude inlarged you muſt find your Rumb, as before in the like caſe upon the Plain Chart, which may be done by the little Table of Tangents.

A Figure of the true Sea-Chart.



As the latitude inlarged	9 deg.	97 parts
To the degrees of longitude	6	75
So is the Radius	10000	
To the taugent of the Rumb	6770.	

Which is the Tangent of 34 deg. 10 parts.

Or elſe thus by theſe Tables, find 9 deg. 97 parts, or 10 degrees (which it comes to very neer) in the margent, and turn over the Tables, till you find 6 deg. 75 againſt it in the Table of Tangents; this you ſhall find exactly at 34 degrees, ſo that you may conclude this is the angle of the Rumb between the two places, being much about the third Rumb from the Meridian, which is 33 deg. 45.

Now for the diſtance of the 2 places.

The Rumb being thus found, the diſtance is much more readily found; For you need only find the true difference of latitude, which is 6 degrees in the margent, and the Secant againſt it, under this angle of the Rumb 34 deg. is 7.24, which ſhewes the diſtance of the two places, to be 7 deg. 24 parts, that is 145 leagues *fere*, or 434 miles and an halfe *fere*.

If you will performe this by Calculation, uſe either of theſe wayes.

As the Coſine of the Rumb Coſ. 34.10	8281
To the true difference of latitude 6 deg.	6 d. 00
So is the Radius	10000
To the diſtance required	7 d. 25

Or elſe ſomewhat better conſider the former worke, and more agreeable to theſe Tables.

As

As the Radius	10.00
To the difference of latitude	6 d. 00
So the Secant of the Rumb 1 Sec. 34.10	12076
To the diſtance	7 d. 25

I might here make a ſhew of many more Propoſitions, by varying ſome of theſe; but theſe containe all others, and in your keeping of your account, there will be need of no others at all, neither of any other way of performance of them, this being the beſt and plaineſt, and therefore I will not trouble you with any other.

CHAP. VII.

Of ſayling by a Great Circle.

THat which I have ſaid in my *Geometrical Sea-man* concerning this ſubject is ſo plain and practical; that I am confident there can be no better way to performe thoſe Propoſitions; And therefore I count it needleſſe to ſpeak any thing hereof: eſpecially ſince, when you have found out the way of the Great Circle according to its latitudes and longitudes, you muſt thereby ſet it into your Chart, and ſo keep your account by Rumb and diſtance, according to the rules aforeſaid.

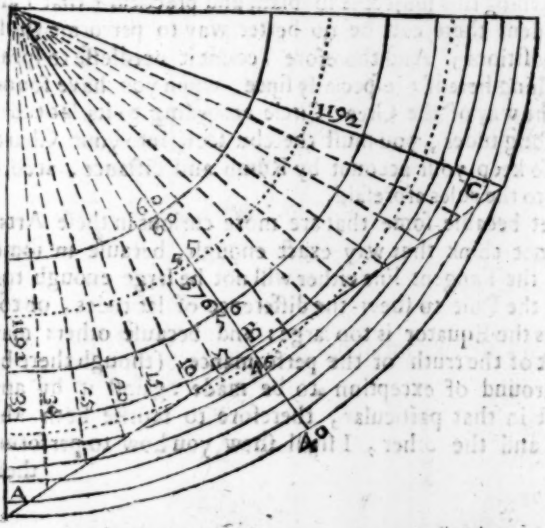
Yet becauſe ſome that are more curious in theſe Arts, may not think that way exact enough, becauſe in ſome caſes the Tangent line either will not be large enough toward the Pole to ſhew the difference of latitudes, or towards the Equator is too large: and becauſe others may doubt of the truth of the performance, (though there be no ground of exception to be made againſt it by any Artiſt in that particular, therefore to ſatisfie both the one and the other, I ſhall ſhew you how to performe theſe

theſe concluſions by theſe Tables, ſo that they may find the latitudes of the Arch of the Great Circle, as exactly as they pleaſe, to minutes, or hundred parts of a degree. And for the demonſtration of the truth thereof I ſhall not performe thoſe concluſions, as (others uſe to do, by Spherical Triangles, but reduce them into plain Triangles, ſuppoſing the ſides thereof to be Tangent lines, by which way the work of Calculation will be more plain and eaſie, and the truth of the foreſaid Geometrical way fully demonſtrated.

Propoſition 1.

To find the latitudes and longitudes of the arch of a Great Circle, for a parallel courſe.

Let the example be the ſame as in my *Geometrical Seaman*, ſuppoſe two places, in the parallel latitude of 50 degrees, and let their diſtance of longitude be 70 degrees, and it is deſired to know the latitudes of the Great Circle, for every fifth degree of longitude?



Theſe Circles are drawn by the Tables of Natural Tangents, counting the latitudes by their complements from the pole or Center P.

Let the two places be ſet upon the Inſtrument, or upon ſuch a part thereof as this here; wherein P repreſents the Pole, A and C are the two places in the Parallel of 40 degrees, being 70 degrtes of longitude from each other. Now I ſay a part of the Great circle paſſing by theſe two places is the ſtraight line A B C, drawn from the one place to the other, which as it croſſeth the paralle's of latitude, at the ſeveral degrees of longitude, ſhewes the true latitudes and longitudes of the ſaid circle from the Equator.

Now for the proof of this, and alſo the more exact finding of the degrees and minutes of latitude; Let this triangle A P C be conſidered as a plain Triangle, the two ſides whereof A P and P C, are 50 degrees, being the complement of the latitude of theſe places from the Equator, now theſe ſides, being Natural Tangents, take the Tangent of 50 deg. (out of the little Table of Tangents) which is 1192, and this is the length of either of the ſides A P, or C P. Thus you have two ſides of this oblique Triangle, and the angle between them at P, which is 70 deg. the difference of their longitude.

In the next place you muſt reduce this oblique triangle A P C, into two right angles, by letting fall the perpendicular, upon the point B. Now this is eaſily done, in this parallel queſtion, by dividing the foreſaid angle of longitude 70 in halfe, which is 35 deg. and thus you have two right angled triangles, A P B, and C P B, all whoſe angles are known, and the Hypothenuſalls, which are alike in both the triangles, ſo that the reſolution of the one will ſerve for the other.

Thirdly, by theſe things known, you may find the length of the perpendicular P B, by the firſt caſe of plain Triangles. For if you turn to the angle at P which is 35 deg. and find the Hypothenuſal ſide A P 1192 in the margent, you ſhall find in the Table of Sines; For the Perpendicular P B 976.37.

For

For 11.00	Perpendicular	09.01
For 00.92		75.37
Which added makes		976.37

Now look theſe numbers in a Table of Natural Tangents, you ſhall find the Perpendicular P B is 44.31 *C. pts* or 19 min. Now this perpendicular ſide being 44 deg. 19 from the Pole P, the complement thereof is the greateſt latitude of the Great Circle from the Equator, which is 45 deg, 49 min. or 69 parts.

Fourthly, if you leave outthe two laſt fignres of the perpendicular as being of little value, and account the line P B to be only 976, make this your Radius, and ſo the pricked lines from the Pole P, to the line of the Arch B A or B C, will be ſo many Secants, in proportion to the ſaid Radius, according to any angles of longitude you pleaſe, which need not be above every fifth degree of longitude, as they are here pricked our. And now if you turn to theſe angles of longitude in your Tables, and find this Radius 976 in the margent, the ſecant againſt it will give you the true length of the lines from P, which are all one as I ſaid before on both ſides the perpendicular B.

Thus for the line P 5, the angle at P is 5 deg. and the Radius 976, turn to the Table of 5 deg. you ſhall find,

For 97 0	The Secāt is 97.37	which is the tang. of 44.21 *pts*
For 00.6	60.2	whoſe compl. is 44.59 *pts.*
which added makes	97.97.2	which is the latitude for that longitude.

Thus for P 10, the angle at P being 10 degrees find the foreſaid Radius 976, in that leafe of the Tables, belonging to 10 deg. and you ſhall have,

For

For 97.0 The Secant is 98.49 The tangent of 44 d. 74 *pts*
For 00.6 60.2 whoſe comp. is 45 26

99.09.9 the latitude for this longitude.

And ſo for the other lines according to their ſeveral angles.

		d. pts.		*d. pts.*
For P 5	Secant 101.04	Tang. 45.30	Lat. Arch	44.70
For P 20	Secant 103.87	Tang. 46.09	Lat. Arch	43.91
For P 25	Secant 107.69	Tang. 47.12	Lat. Arch	42.88
For P 30	Secant 112.69	Tang. 48.42	Lat. Arch	41.58
For P A	Secant 119.14	Tang. 50.00	Lat Arch	40.00

And thus by theſe Tables you have the chief thing which is needful in your ſayling, *viz.* the longitudes and latitudes by which the Arch of the Great Circle doth paſſe between theſe two places. As for the angles of Poſition and the diſtance, they are little to the purpoſe, onely to help to find out theſe longitudes and latitudes of the arch, in the ordinary way of calculation. And though I have been ſomewhat long, endeavouring to make every thing plaine for young beginners, yet the thing of it ſelfe is of more eaſie and ſpeedy performance, then any calculation by Logarithmes.

And yet becauſe the diſtance between places ſeemes a thing very deſirable. Firſt, if you pleaſe you may find the diſtance of theſe two places (by the rules of the laſt Chapter, finding the difference of longitude of theſe places being 70 deg. in the margent of theſe Tables under the ſine of 40 deg. which is their latitude, for ſo their diſtance is 53 deg. 62 parts.

Laſtly, it may be performed by theſe brief Tables of Natural Sines, and that with as much eaſe, as by the Logarithms, according to this proportion.

As the Radius
To the Sine of halfe the differ. long. 35 deg. 5736
So the Coſine of the cõmon latit. Coſine 40 7660
To the Sine of halfe the diſtance 26.07 4392

Turn to the degree of the latitude, (becauſe the Sines are inverted) whoſe Sine is 76.60, and there find the Sine of 35 deg. which is 5736 at twice in the margent, ſo you ſhall have 4392, whole Sine is 26 deg. 07 parts, which is halfe the diſtance, this doubled is 52 deg. 14, which is the whole diſtance.

The work is briefly this, under the Sine of 40 deg.

For 57.00 in the margent, the Table yields 4366
For 00.36 in the margent, the Table yields 2757

4 9357

Which cutting off the two laſt figures may be 4394. as before.

Propoſition 2.

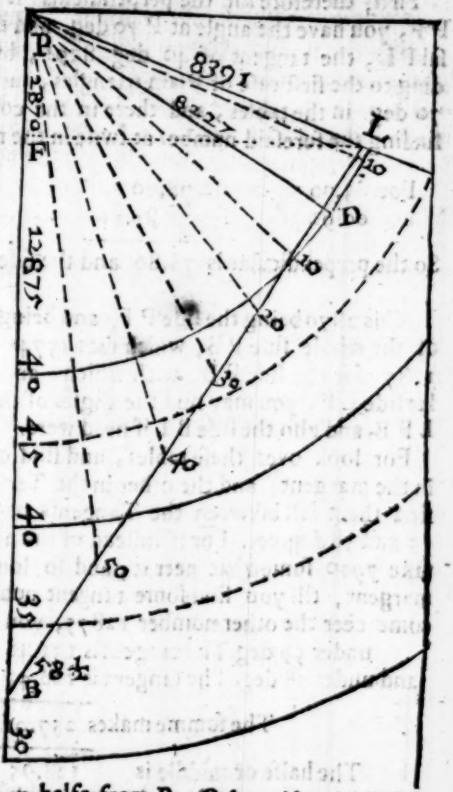
How to finde the longitude and latitudes belonging to the Arch of a Great Circle between two places which differ both in longitude and latitude, lying both upon the one ſide of the Equator.

Let the two places be the *Bermudas* or *Summer Iſlands*, whoſe latitude is 32 deg. 25 min. or 41 parts, and the *Lyzard* in the latitude of 50 deg. and their difference of longitude 70 deg. and it is deſired to find the latitude of the Great Circle at every fifth degree of longitude between them.

Firſt ſet the two places upon the Inſtrument in my *Geometrical Seaman*, or in ſome ſuch figure as this, according to their longitudes and latitudes, the *Bermudas* at B, the *Lyzard* at L, and P repreſents the pole of the World.

Here now you have a Triangle, whoſe ſides are known, *viz.*

viz. P B the tangent of 57 deg. 59 parts 15745, and P L the tangent of 40 degrees 8391, (being the cotangents of the latitude of the two places) and the angles between them being 70 degrees.



This figure is alſo drawn by the Table of Natural Tangents.

Now here you might ſave much labour, if with the Ruler and Compaſſes, you would let fall the perpendicular, or draw the line P D ſquire wiſe to the line B L, which will fall about 11 deg. and an halfe from L, and 58 deg. and an halfe from B. Otherwiſe you muſt be forced firſt to let fall a perpendicular from L, upon the perpendicular P D, which muſt do the chiefe buſineſſe, being the Radius for the Secants of the Arch.

Yet this may be done as well by theſe Tables, as by any others, for if you work according to Spherical Triangles, the very ſame things muſt firſt be found out, and require as much trouble.

First, therefore for the perpendicular L F, and the ſide P F, you have the angle at P 70 deg. and the Hypothenuſal P L, the tangent of 40 deg. 8391, by which according to the firſt caſe of Plain triangles, turn to the Sine of 70 deg. in the tables, and there in the columns of Sines finding the foreſaid number at twiſe in the margent.

For 83.00	78.00	28.29
00.91	85.51	31.12

So the perpendicular is 78.86 and the ſide 28.70

This 2870 being the ſide P F, and being ſubſtracted out of the whole ſide P B, which was 15745, there remaines 12875 for the ſide F B, with which, and the perpendicular ſide L F, you may find the angles of this right Triangle L F B, and alſo the ſide B L if need were.

For look over theſe tables, and find one of theſe ſides in the margent, and the other in the Tangents, you ſhall find them fall between the Tangents of 31 and 32, and 59 and 58 degrees. For if inſtead of the number 7886, you take 7900 ſomewhat neer it, and ſo look out 79 in the margent, till you find ſome tangent number which ſhall come neer the other number 12875, you ſhall find,

under 59 deg. The tangent is 131.48 The ſecãt 153.39
and under 58 deg. The tangent is 126.43 The ſecãt 149.08

The ſumme makes	257.91	302.47
The halfe or middle is	128.95	151.23

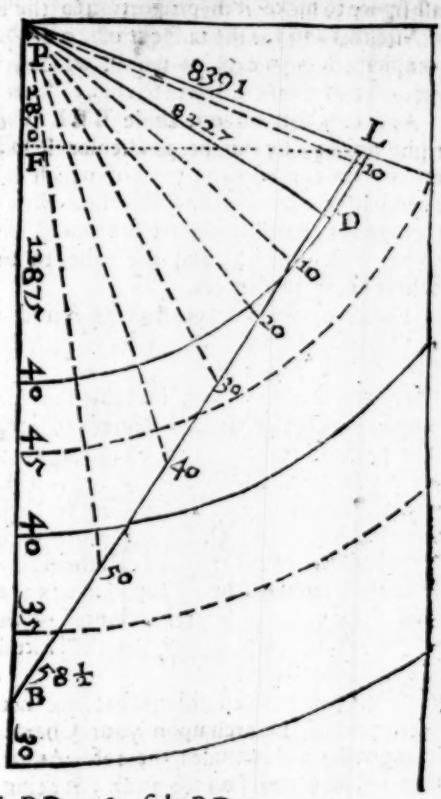
Which comes very neer the appointed numbers.

If you will find this angle at B more exactly, uſe this proportion;

As the ſide F B.	12875
To the ſide L F	7886.
So is the Radius	10000
To the tangent of the angle B	6125
Which is the tangent of	31 d. 49 *pts.*

Ha-

*Having this angle at B, 31 deg. 49 parts, you may find the perpendicular P D, and the ſide D B, by the firſt caſe of plain triangles. For the whole line B P will be the Hypothenuſal, which being 15745, theſe ſides will be found in the table of Sines, under the angle of 31 degrees and an halfe, to be thus.



*The angle here uſed is not the true angle of poſition, which uſeth to be found in Spherical operations, but a plain right lined angle ſomewhatneer it, which doth the work more readily, and plainly.

For	15000	ſide P D 07.84	ſide B D	12.92
For	740	38.66		63.52
For	5	03		04
		8.22.69		13.55.56

Which figures joyned are 822.69 and 135556.

So the ſide P D being the perpendicular and which is the chief thing needfull to be known, is 8227, omitting the laſt

laſt figure to make it in proportion to the Radius of 1000;
And this 8227 is the tangent of 39 deg. 44 parts, whoſe complement is 50 deg. 56 parts, which is the greateſt latitude of this Great Circle.

And thus this oblique angle B P L is divided into two right angles, by this perpendicular P D, all whoſe ſides and angles are known, moſt of which labour might have been ſpared, by drawing this line with your Ruler and Compaſſes, ſo you might have found the one angle at P to be 58 deg. and $\frac{1}{2}$, and the other to be 11 deg. $\frac{1}{2}$, the whole being 70 degrees.

Either of theſe wayes having found theſe angles you muſt conſider how theſe angles of longitude have relation both to the places B or L, and alſo to the perpendicular P D, and ſet them down in a table that ſo you may find the angles which the deſired degrees of longitude make with the perpendicular. Then according to the Radius of the perpendicular, which here is 8227, ſeek the ſeveral lines from P to the line L B according to their angles with the perpendicular, which lines are onely the Secants of the ſaid Radius, and therefore I call them Secants in the Table, and theſe numbers being found out in a table of tangents, will ſhew you the ſeveral diſtances of the circle from the Pole, whoſe complements, are the latitude of the ſaid arch in thoſe longitudes.

Thus you have all things that are neceſſary for the deſcription of this arch upon your Chart, according to the longitudes and latitudes thereof. As for the angles of poſition, they are of no uſe at all, it being better to look after the Rumb, which this Circle makes upon your Chart. But the neereſt diſtance between theſe two places ſeemes a thing more needfull to be known, which though the line B L between the two places being 15100, will not ſhew it truly, though it be meaſured either way in the tangent line; yet by what hath been done, you are in a good forwardneſſe to attaine the knowledge thereof, according to the ordinary rules of Spherical triangles.

The

The angles of ongitude from B.		The angles from the perpendicular P D.		Secants to the Rad 8227	The Tang of the numbers.		The comp. shewing the latitude of the arch.			
0 *d.*	0 *pt*	58 *d.*	50 *pts*	15745	57 *d.*	58 *pts*	32 *d.*	42 *pts*	Which makes in min. or 60 parts	25 m
5	0	53	50	13833	54	14	35	86		52
10	0	48	50	12417	51	15	38	85		51
15	0	33	50	11343	48	60	41	40		24
20	0	48	50	10513	46	43	43	57		34
25	0	33	50	9861	44	60	45	40		24
30	0	28	50	9363	43	12	44	88		53
35	0	23	50	8972	41	90	48	10		06
40	0	18	50	8676	40	95	49	05		03
45	0	13	50	8466	40	25	49	75		45
50	0	08	50	8306	39	71	50	29		17
55	0	03	50	8243	39	50	50	50		30
The		Perpendicular		8227	39	44	50	56		34
60		1	50	8230	39	45	50	55		33
65		6	50	8280	39	63	50	37		22
70		11	50	8391	40	00	50	00		00

For in the letting fall the first perpendicular from L to F, you found the side P F to be 2870, which is the tangent of 16 deg. 1 part, and this substracted from the whole side P B the complement of the greater latitude 57 deg. 59 parts, there rests 41 deg. 58, for the side F B.

Thus the first part of the operation is performed.

The second is thus, which you may best performe by the Logarithme Sines, it being to be all wrought by Sines.

As the Cosine of P F Cosine 16 d. 01 *com. Ar.*	0,01 71 58	
To the Cosine of P B Cosine 41 58 *pts.*	9,8739 15	
So the Cosine of P L Cosine 40 00 *pts.*	9,8842 54	
To the Cosine of the dist. B L Cosine 53.47 *parts*	9,775332	

Prop.

Propoſition 3.

When two places are ſo ſcituated, that the one is under the Equinoctial, and the other toward one of the Poles, having difference of longitude, and latitude: how to find out the longitudes and latitudes of a great Circle between them?

The firſt example when the two places differ juſt 90 deg. in longitude.

If the places differ juſt 90 deg. in longitude the worke will be very plain and eaſie. For you muſt make the Tangent of the latitude of the place your Radius, and then the Secants agreeable to that Radius, according to their ſeveral angles of longitude, will be the Tangents of the latitude from the Pole.

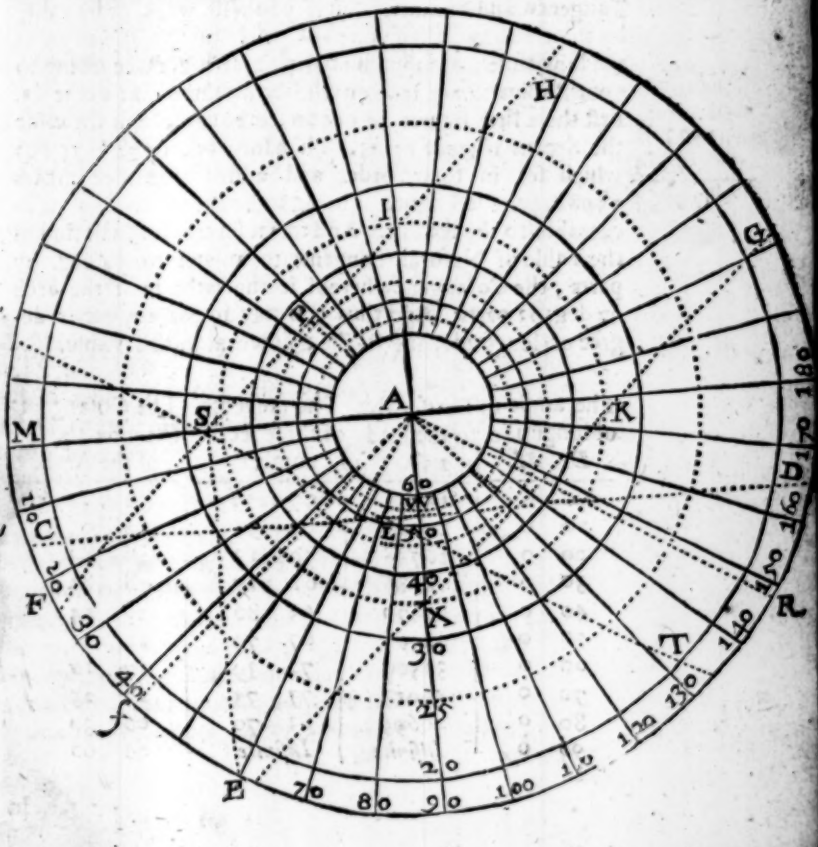
See the 8th. Chapter of my *Geometrical Sea-man.*

Thus in the figure following let S repreſent the *Summer Illands*, according to the longitude and latitude thereof; the pricked line S E drawn from hence at right angles with the line A S, repreſents a part of the Arch of a great Circle, toward a certain place under the Equinoctial, whoſe difference of longitude from S is juſt 90 deg. Now as this line S E ſhews the latitudes and longitudes of this arch according to the largeneſſe of the ſaid Radius, and as far as the projection will give leave, ſo it ſhewes a moſt plain way for the calculation thereof, when you require more exactneſſe.

For here it is plainly viſible to you, that the Cotangent of the latitude, or the diſtance of S from the Pole A, muſt be the Radius, and then that the ſeveral lines of longitude drawn from the Center A to this line S E, are the Secants of the ſaid Radius according to the angles of longitude, which meaſured by the circles in the figure, or the tangents of latitude in the tables, ſhew the Cotangents of the latitudes of the ſaid arch, according to the longitude deſired. So that this proportion will hold good.

As

This is a Projection of almoſt one halfe of the Globe in plano, *wherein the Center repreſents the Pole, the circles are the parallels of latitude, which are drawn by a line of Natural Tangents; the ſtraight lines drawn from the Center are the Meridians, and as theſe are all ſtraight lines, ſo any great Circle drawn upon this Projection will be a ſtraight line; and any ſtraight line drawn upon this Projection will be a part of a great Circle, and ſhew the longitude and latitudes thereof.*



As the Radius	10000
To the ſide A S Cotangent latitude 32 deg. 25	15745
So the Secant of the angle of longitude 10 deg.	10154
To the Cotangent of the latitude of the Arch	15987

Thus you may worke it by the ordinary Tables of Sines, Tangents and Secants, But if you will work more eaſily by theſe Tables, then you need onely turn to the angle of the longitude, as ſuppoſe 10 deg. and there according to your Radius 15745 take out the Secant thereof at 2 entryes, firſt the 2 firſt figures or 15000, the Table will ſhew for
1523 the Secant thereof 15.23. Then for 745, or 74½ 75 64:
7564 which ſet in their order and added together makes
159864 15986.4 the laſt figure 4 being to be cut off to make it agreeable to the Radius. And this number you ſhall find in the Table of Natural Tangents to anſwer to 57 deg. 97 parts, the Cotangent whereof is the latitude of the arch 32 deg. 03 parts. And thus you may do for any other degree of longitude, and ſet them down as in this Table.

The angles of longitude. D.	M.	The ſecants to the Rad. 15745	The tangents of thoſe ſecant numbers.		The Cotangents ſhewing the lat. of the Arch.	
			d.	pts	d.	pts.
00	0	15745	57	58	32	42
10	0	15986	57	97	32	03
20	0	16758	59	17	30	83
30	0	18186	61	19	28	81
40	0	20379	63	86	26	14
50	0	24496	67	79	22	21
60	0	31500	72	39	17	16
70	0	46053	77	75	12	25
80	0	40699	83	70	06	30
90	0	*Infinite*	*Infinite*		00	00

In,

In like manner the line D W ſhewes the arch of the Great Circle from the Straights of *Magellan* being in 53 deg. South latitude, and the Iſland of St. *Thomas*, being under the Equinoctial and having 90 deg. difference in longitude. Which are thus to be caſt up. The line A W ſhewing the latitude of the ſaid ſtraights, is to be Radius, and ſo the Secants from A to the line W D, ſhew the complements of the latitudes of the arch according to their angles of longitude as before.

A ſecond example when the two places differ more or leſſe then 90 deg in longitude.

It is ſomewhat more trouble (but not much) when the angle of difference of longitude is more or leſſe then 90 degrees; for here you muſt firſt find out where the perpendicular which muſt be your Radius will fall upon the Arch.

But yet this is eaſily performed in this caſe; for the complement of the difference of longitude, is the angle of the place from the perpendicular, ſo that you may readily frame your Table and ſet down your angles both from your place, and from the perpendicular.

Thus ſuppoſe you were to ſayle from S, to a place juſt under the Equinoctial, having 42 deg. difference of longitude; Draw the line S F at the angle of 42 deg. from the point *S*, extending it on the other ſide of S to I or H, and let fall the perpendicular upon this line in the point P, which as I ſaid before, is the complement of the difference of longitude, ſo that S P is 48 degrees.

Theſe angles being known, the length of the perpendicular A P will be found by the length of the Hypothenuſal A S,

For as the Radius	10000
To the ſide A S	15745
So the ſine of the angle at S 42 d.	6691
To the ſide A P the Perpend.	10535

1004
4952
105352

The ſame number theſe tables will give, for if you turn to the angle 42, you ſhall finde in the Sines under 43, (the column being tranſpoſed) for 15.000, to 10.04; and for 74 4952, which rightly placed and added, make 10535.2, the laſt figure being cut off. This is the length of your Radius A P, which is the tangent of 46 deg. 49 parts, the complement whereof is 43 deg. 51 parts, which is the greateſt latitude of this Arch.

Now the angles at the perpendicular, and this Radius found; the other numbers are the ſecants of thoſe angles belonging to this Radius 10535, which you may ſoon take out of the table of Secants, and ſet down as in the following table, and ſo find the latitude of the Arch as before.

Propoſition 4.

How to find the longitudes and latitudes of the Arch, when the two places lye the one Northward, the other Southward from the Equinoctial.

I have ſhewed plainly in my *Geometrical Sea man*, that though the arch upon this projection doth not ſo viſibly croſſe the Equinoctial line, becauſe the tangents there run out to an infinite length: yet you may find very well where it will croſſe the Equinoctial; by drawing a line parallel to any part of the arch, through the Center at A. Thus the line A F parallel to the line S F, doth croſſe the Equinoctial at 42 deg. as you may ſee by the degrees in the Circle. And ſo likewiſe the line E X K being parallel to this line ſhewes the Arch repreſented thereby, which comes from the ſame point of the Equinoctial, and is the continuance of the Arch S F upon the other ſide of the Equinoctial. And thus you may continue the arch round about the Globe if need were, as theſe two parallel lines F S I H, and E X K G, being equally diſtant from the Center A, are the greateſt part of this arch round about the Globe.

Ha-

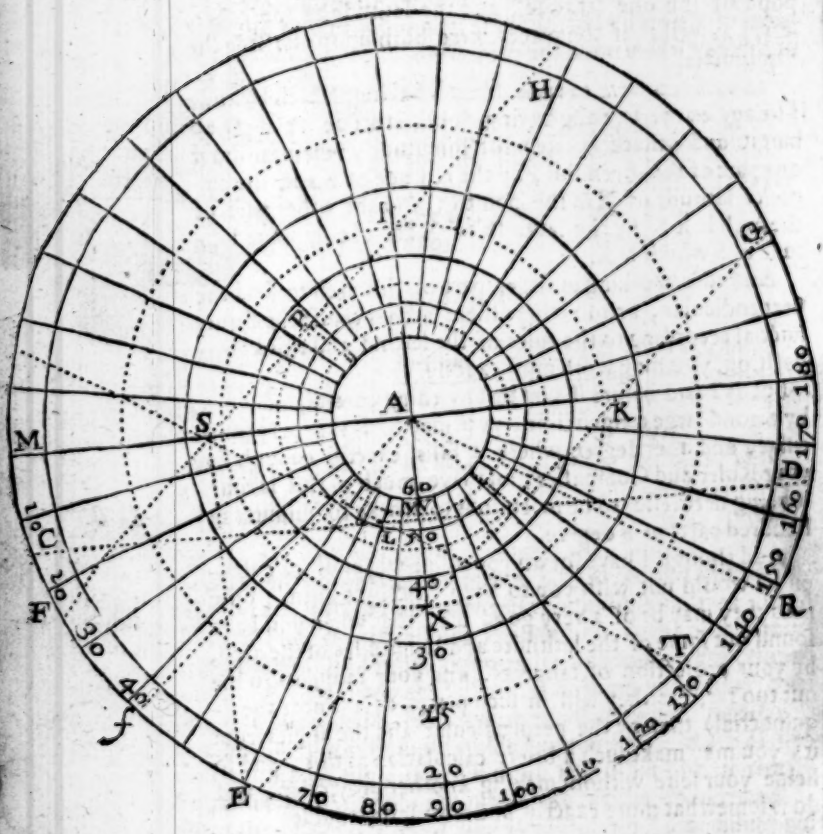
Having therefore any two points of the arch you may find all the parts thereof. And theſe two points you alwayes have, for in this ſcituation, though you cannot draw this one line by both the latitudes, yet the oppoſite point of the one latitude, and the latitude of the other, ſerves as well as if the places were both upon one ſide the Equinoctial.

Thus if you were to ſayle from S having North latitude 32 deg. 42 parts, to X having South latitude 35 deg. 20 parts, and diſtant 90 deg. of longitude, you may draw one part of this Arch S F, by the latitude of S and the oppoſite latitude of X in the point I: and the other part of the arch E X K by the latitude of X and the oppoſite latitude of S which is K.

And thus working in either part of this arch to find the perpendicular, and ſo where theſe arches croſſe the Equinoctial according to the rules of the ſecond and third Propoſition, you may work moſt exactly.

But as I ſaid before if you be any thing careful, and work by a good large tangent line, you may find this perpendicular, and the degree where it falls exactly enough by your Ruler and Compaſſes, and ſave much of this labour, it being needleſſe to be ſo curious to worke to minutes or hundred parts of a degree.

And though I have ſhewn you theſe wayes of calculation, I would not wiſh you to keep ſtrictly to them; only thus they may be of a very good uſe, that when you have found out ſome of the latitudes and longitudes of the arch, by your projection of tangents, and your tangents runne out too far, (as they will in ſuch places as are neer the Equinoctial) then by the perpendicular and the angles from it, you may make ſuch a briefe calculation as this, and ſo helpe your ſelfe without making another projection, and do it ſomewhat more exactly, and with leſſe trouble.


H
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110
120
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140
150
160
170
180

Thus

Thus in this example having drawn the line I S F and found the perpendicular to fall in P, at 48 degrees of longitude from S, and the length of it to be 10535, or the tangent of 46 deg. 49 parts, make a table of the angles and work this Radius 10535, and you shall find the latitudes of the arch as in this table, though you had but two or three of them upon the projection.

The angles of longitude from the point *S*.		The angles from the perpendicular P.		Secants to the Rad 10535	The Tang of these secants,		The complem. or latitude of the arch.		
0	0	48	0	15745	57	58	32	42	*North latitude*
10	0	58	0	19880	63	30	26	70	
20	0	68	0	28123	70	43	19	57	
30	0	78	0	50667	78	84	11	16	
40	0	88	0	301828	88	10	08	90	
The		Equi-		noctial.					
50	0	98	98	75697	82	47	07	53	*South latitude*
60	0	108	72	34092	73	65	16	35	
70	0	118	62	22440	65	98	24	82	
80	0	128	52	17112	59	70	30	30	
90	0	138	43	14176	54	80	35	20	

(or take their compl. to 180.)

The first part of this table shewes the way of the arch, from S to the Equinoctial, the latter part shewes the way, from the Equinoctial to X in 35 deg. 20 parts of South latitude, wherein all things are so plain, that I hope they need no farther explaining, *only here you may take notice, that the angles at the perpendicular being above 90 deg. in the later part of the Table, you must take their complements to 180, which is a sure rule in any like case.

*The angles being above 90 deg. take their complements to 180 degrees.

And thus these latitudes and longitudes of the Arch being found out, your best way will be to prick them down upon your Sea-Chart, and so draw a bending line thereby

from

from point to point, by which meanes you ſhall ſee all your voiage, how to direct your courſe ſometimes upon one point and ſometimes upon another point of the Compaſſe, that ſo you may alwayes keep as neer the arch of the Great Circle as you can, by which meanes you will not onely ſayle the neereſt way, but many times the moſt convenient way, eſpecially when you are to run your courſe in or neer a parallel of Eaſt and Weſt. As you may ſee this fully explained in the latter end of the fifth Chapter of my *Geometrical Sea-man.*

CHAP. IX.

Shewing ſeveral Propoſitions very uſeful both in the Art of Navigation and Surveying.

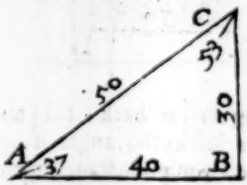
THe Art of Navigation, and the Art of Surveying are more like one another then many think of, for that which the one doth upon the land, the other doth upon the water, which is to find the true diſtances and angles from place to place, onely the Surveyour worketh upon ſhorter diſtances, and which requite ſometimes more exactneſſe; and the Sea-man in larger, wherein he neither can nor need be ſo exact. And alſo he that will be a good Sea-man, muſt have ſome skill in this Art of Surveying, that ſo he may be able to deſcribe the Coaſt of any Countrey or Iſland, Port or Harbour, which he ſhall happen to diſcover. And therefore as I ſhall not much wander from my intending purpoſe of Sayling, applying moſt of theſe Propoſitions that way: ſo in ſome things I ſhall direct the Surveyour ſo to order his worke according to theſe Rules and Tables; that he ſhall performe his work hereby, better then by any other Inſtrument whatſoever.

And my intent here is not to ſhew you the uſe of the ſeveral Inſtruments whereby theſe things may be performed, but

but to help you in the calculation thereof by theſe Tables, having found the angles and ſome of the lines by any inſtruments fit for the purpoſe.

Propoſition 1.

Having the ſloaping ſide of an Hill, and the angle at the foot thereof, to find the perpendicular height, and the length of the Horizontal line thereof.



Let the ſlope ſide A C be 50 poles, and the angle at A 37 degrees.

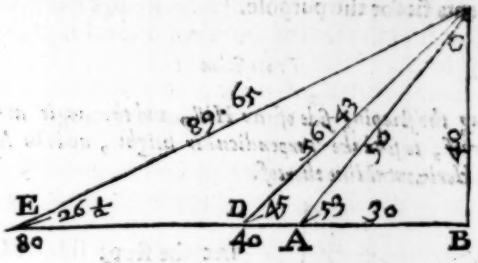
As the Radius or ſine of 90 degrees
To the ſloap ſide A C 50 poles;
So the ſine of the angles at A or C,
To the ſides oppoſed thereto.

Look in theſe Tables for the angle at A which is 37 deg. and find the length of the ſloap ſide which is 50 poles in the margent, and in that line in the two columns of Sines, you ſhall have 39 poles 93 parts, for the one ſide, and 30 poles 09 parts for the other ſide, which is 40 poles *ferè*, for the Horizontal line, and 30 poles or little more for the perpendicular line.

Propoſition 2.

To find the height of an Houſe, Steeple, Tower or Tree from the ground, and the length of the ladder which will ſcale it.

If you can approach the bottome or foot of the thing whoſe height you deſire, the thing is eaſily performed by



the quadrat, or croſſe ſtaffe, going ſo far back, till you make the top of the thing to appear juſt at the angle of 45 deg. and then meaſure the diſtance from your ſtanding to the thing, and it is equal to the height thereof, or more exactly to ſo much thereof as is above the level of your eye. And then the ſloap ſide is found by adding together the two ſquares of the ſides, and ſubſtracting the ſquare root thereof. Thus the angle at D being 45, and the diſtance from D to B being 40 feet or yards, the height B C is alſo 40 feet or yards. If you cannot come ſo neer as to meaſure between your ſtation of 45 deg. and the baſe of the thing by reaſon of ſome Moat or Wall, yet by the proportion of the line of quadrature, you may help your ſelfe; In which caſe it is beſt to take ſuch a diſtance backward for your ſecond ſtation, as may be equal to the height deſired, wherein the Quadrat or the degrees of the Quadrant will direct you.

Thus if you could not meaſure the diſtance from D to B, then goe backward from D to E, till you ſee the height C to make an angle of 26 degrees and a halfe, and meaſure the diſtance between D and E, it will be likewiſe 40 feet or yards equal to the height B C, the whole line E B being 80, which is double to the height.

If you cannot help your ſelfe any of theſe wayes, but are

are forced to a certaine ſtation, then obſerve the angle at your ſaid ſtation as at A, which is 53 deg. and meaſure from thence to the foot of the thing, according to the line A B 30 feet.

Then as the Radius or Tangent of 45 deg. 10000,
To the ſide A B 30 feet;
So the tangent of 53 deg. 13270,
To the height B C 39 feet 81 parts;
And ſo is the Secant of 53 degrees, 16616,
To the ſloap line A C 49 feet 85 parts.

Look in the Tables for the angle 53 deg. and againſt 30 in the margent, the tangent of 53 deg. is 39.81, and the ſecant is 49.85, which is very neer 40 feet, and 50 feet.

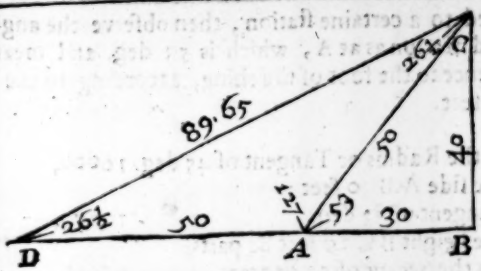
In like manner turn to the angle 45, and there againſt 40 in the margent, you ſhall have the Tangent or the line B C 40, and the Secant or line D C, 56.43 parts. So turn to the angle at E 26 deg. ½, find the diſtance E B which is 80 in the margent, the Tangent or line B C is 40, and the Secant or line E C is 89.65 parts.

Propoſition 3.

To find the ſame things another way.

Though the quadrat is good to find the perpendicular as I ſhewed before, yet it doth not ſo readily ſhew the Hypothenuſal or ſcaling ladder, which in many caſes is the chiefe thing looked after. This may be better found by the angles of the *Quadrant*, if you take notice of this obſervation, which I think few hitherto have thought of.

Let your firſt Station be any where at randome, or as neer as you can come to the foot of the Tower or Wall for the ditch or moat, as ſuppoſe at A, and obſerve there the angle of the height of the thing, which let be any degree



whatſoever, as here it is 53 deg. I ſay if you goe ſo far backward from this Station at A toward D till you make the thing appear juſt at halfe the foreſaid angle, which is here 26 deg. ½ that being the half of 53 deg. that then this diſtance from A to D is the true length of the ſloap ſide A C without any farther trouble, and a ladder of that length ſhall ſcale the ſaid moat and wall, allowing onely for the height of your eye above the ground

That this muſt needs be ſo, I prove it thus. In the Triangle A B C the angle at A is obſerved to be 53 deg. therefore the obtuſe angle at A, of the triangle D A C being the complement thereof to 180 deg. muſt needs be 127 deg. And the angle obſerved at D being 23 deg. ½, being added to 127 deg. theſe two angles make 153 deg. ½, therefore the third angle at A muſt* needs be likewiſe 26 deg. ½, being likewiſe the complement of the ſaid two angles 153 ½ deg. to 180. Now theſe two angles at D and C being both equal, *viz.* 26 deg. ½, therefore the ſides A D and A C muſt alſo be equal. So that the ſide A D being meaſured and found to be 50 feet; the ſcaling ladder A C muſt likewiſe be 50 feet.

180
53
127

127
26½ 180
153½ 026½

*Theſe are two fundamental Axioms, that the three angles of a Triangle are equal to 180 deg. and that the ſides are alwayes in proporton to the oppoſite angles: upon which this Propoſition is grounded and proved: which though it hath not been obſerved, yet is very brief and uſeful both in this and ſome other following caſes.

And now if by this line A C thus found out to be 50 feet, you would alſo know the height of the wall B C, and the

breadth

breadth of the ditch A B, turn to the angle obſerved at A which was 53 deg. and there againſt 50 in the margent under the two columns of Sines, you ſhall have 39 feet 93 parts, for the height, and 30 feet 9 parts for the wideneſſe of the ditch.

Propoſition 4.

Being upon the top of a Tower, Steeple, or Maſt of a Ship, and obſerving the angle of the diſtance of any thing from you, to find the true diſtance thereof.

Theſe things may be found out by the Quadrat or Quadrant, for obſerving the proportional part of the Quadrat, you ſhall find the things to be 1, 2, 3, 5, or more times diſtant then the height of the Tower or *Maſt*. So that if you know the height of them you may ſoon find the diſtance.

But this may ſomewhat more eaſily be found by the angles of the *Quadrant*, eſpecially if the numbers obſerved do not fall in equal parts, but that you muſt uſe proportion.

For in this caſe here is nothing to doe in the uſing of theſe tables, but turn to the angle of the diſtance, or the complement of the angle of depreſſion, and find the height of the Tower or *Maſt* in the margent, and in that line, the tangent of diſtance, or cotangent of depreſſion, ſhewes you the diſtance without any more trouble moſt exactly.

Thus let the height of the Tower or Maſt be 40 feet, and let the angle of Diſtance be 89 degrees or one degree under the line of level: the Tangent belonging hereto againſt 40 in the margent, is 2292.00, which ſhewes the diſtance of the thing is juſt 2292 feet. And ſo youmay do for any other angle of diſtance as in this little Table.

The

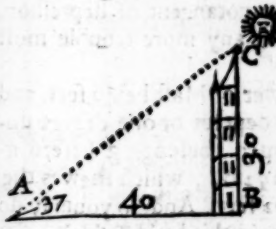
The angle of diſtance. Deg.	The true diſtance *feet pts*	The angle of diſtance Deg.	The true diſtance *feet pts.*
89	2292.00	75	149.28
88	1146.00	70	109.96
86	0764.00	65	085.78
87	0573.00	60	069.28
85	0457.20	55	057.13
85	0380.60	50	047.67
80	0226.85	45	040.00

The like the tables will ſhew you for any other height of the Tower or Maſt in feet or yards, in any other meaſure, or for any other angle of diſtance whatſoever.

Propoſition 5.

By the height of the Sunne and the length of the Shadow, to find the height of any Tree, Houſe, Tower, or Steeple.

This is ſomewhat like to ſome of the former Propoſitions, only this way it may be more practical, for it is an hard taske to find the angle of the height of any Houſe, Tree, &c. unleſſe you have an Inſtrument fitted on purpoſe to a Standard, which may keep it at what angle you pleaſe: But this concluſion you may try (almoſt as well) by any little Quadrant or pocket Inſtrument. For by any of theſe you may obſerve



obſerve the height of the Sunne to a degree, and its halfe or quarters, which will be ſufficient for theſe concluſions.

And thus or any other way knowing the Suns height, and meaſuring the length of the Shadow, the Rule is thus;

As the Radius 10000
To the length of the Shadow,
So the tangent of the Suns height,
To the height of the thing deſired;

Thus let the height of the Sunne be 37 deg. and the length of the Shadow be 40 feet.

Turn to the angle of 37 degrees, and againſt 40 in the margent, you ſhall have for the tangent 30.14, which ſhewes the height to be a little above 30 feet.

Propoſition 6.

Knowing the height of a Tower, Houſe, or Tree, or any perpendicular Stile or Gnomon, to find the length of the Shadow thereof upon the ground to any angle of the Suns height deſired.

Let the perpendicular B C be 30 feet, and the angle of the Suns height 37 degrees.

As the Radius 10000
To the height of the perpendicular C B 30 feet;
So the co-tangent of the Suns height.
To the length of the Shadow.

Turn to the angle of the Suns height in the tables, which is 37 degrees, and there againſt 30 in the margent, the cotangent of 37 degrees, (which is the tangent in the other column) ſhewes the length of the Shadow is 39 feet 81 parts, or 40 feet *fere*.

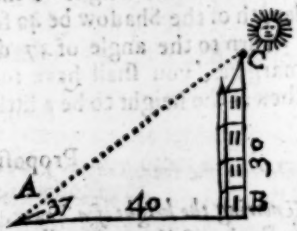
Prop.

Proposition 7.

Knowing the height of the perpendicular, and the length of the shadow, to know the angle of the Suns height.

As the height of the perpendicular.
To the length of the shadow;
So is the Radius 10000
To the Cotangent of the height.

Let the perpendicular be 30 feet high, and the shadow 40 feet long, the Cotangent of the height is 37 degrees.



For turn over the Tables till you find some tangent or other, that shall be neer 40.00 parts against 30 in the margent, this you shall find at the angle of 53, where against 30 in the margent, the tangent is 39.81. So that you may judge the Suns height to be according to the Cotangent thereof 37 degrees.

Proposition 8.

To know when the Shadow of any perpendicular Stile or Gnomon is 1, 2, 3, 4, 5, or 10 times the length thereof.

Look over the Table of tangents, and see at what degrees the Radius which is 10000 doth encrease to such a proportion as to make 20000, 30000, &c. which is twice, three times, &c. the Radius, and the Co-tangents of those numbers shew the height of the Sunne, when the shadow will be so many times longer than the said perpendicular, whether it be Tree, House, Steeple, or any such like. Thus

Thus at 45 deg. the ſhadow is equal to the height.
At 26 deg. 56 parts, the ſhadow is double to the height.
At 18 deg. 43 parts, the ſhadow is three times the height.
At 14 deg. 04 parts, the ſhadow is four times the height.
At 11 deg. 31 parts, the ſhadow is five times the height.

At any of theſe times you may eaſily find the height of any thing by the ſhadow thereof.

Or you may performe this by any walking ſtaffe or ſuch like; for if you find the ſhadow thereof, (being held upright) to be 1, 2, 3, 4, 5, times the length thereof, you may judge the like by the ſhadow of any Tree, Houſe, or Steeple and ſo by meaſuring the ſhadow thereof, at that inſtant find the true height thereof.

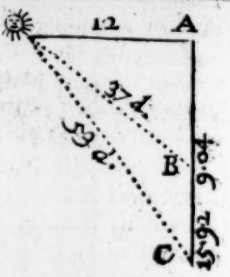
Propoſition 9.

Having the length of any Stile or Gnomon, ſtanding out at right angles with any perpendicular, to find the length of the contrary ſhadow, or the ſhadow upon the ſaid perpendicular, at any degree of the Suns height.

If you divide your Stile or Gnomon into 10 or 100 parts ſo that it may have a viſible proportion to the Radius of Tangents, which is 100, in the firſt part of the columns of the Tables, or 10000 if you take in all the figures, then the tangents of the degrees in the Table, either in the tenth or laſt line thereof, will ſhew you the true length of the ſhadow, according to the proportion of the Radius of your Gnomon, to the Radius of the Table.

But if your Gnomon be divided into any other number of parts the rule is this;

As the Radius or tangent of 45
To the length or parts of the Gnomon
So is the tangent of the angle of the Suns height
To the length of the parts of the ſhadow.



Thus if you take a Carpenters ſquare, whoſe ſhorter ſide is 12 Inches, and would know the length of the ſhadow thereof, upon the longer ſide, being held up perpendicularly, the Suns height being 37 degrees.

Turn to the angle of 37 deg. and againſt 12 in the margent, you ſhall find the tangent thereof is 09.04, that is 9 Inches 4 hundred parts: And here likewiſe you may ſee that ſhadow at 53 deg. which is the co-tangent will be 15.92, that is 16 Inches *fere*.

Propoſition 10.

Obſerving how many Inches the ſhadow of the ſhort ſide of ſuch a Square doth reach upon the longer, to find the height of the Sun thereby.

The Radius here being the ſhorter ſide of the ſquare which is 12 Inches, and the length of the ſhadow being 9 Inches or 16 Inches. And the Suns height is deſired at theſe times.

Turn over the Tables, ſtill having an eye to the number of your Radius (which is 12 Inches) in the margent, untill you come to have a tangent number againſt it, which ſhall be the very ſame, or the neereſt you can find to your number deſired, and that is the angle of the Sunnes height, which in this Example falls out to be much about 37 degrees and 53 deg.

By theſe two concluſions, you may make the hook of any walking ſtaffe to ſhew you the height of the Sun, making a Tangent line upon your ſtaffe. And hereby after the manner of a Cylinder you may draw a Dyall upon your ſtaffe, to ſhew you the hour of the day by the height of the

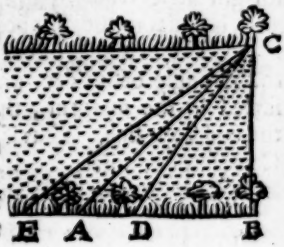
the Sun at any time of the year. And though this will not be ſo uſefull for Sea-men, who ſayle into divers Countreyes, and continully are altering their latitude; yet it is very ready for Land-men, to know the time of the day as they walke abroad.

But yet if the Croſſe Staffe, or an Inſtrument ſomewhat like it were ſo fitted, that it might have a good heavy perpendiculer Staffe of about a yard long, or a good weight at the end, to keep it ſteady; and a light tranſome at the top for a Gnomon, about 10 Inches or a foot long, divided into 100 parts; you may by the table of tangents divide the perpendicular exactly into degrees; which ſhall ſhew you the height of the Sun as exactly and conveniently as any other Inſtrument uſed for that purpoſe, if not better then moſt of them.

Propoſition 11.

To find the diſtance of a Fort or Caſtle, that you dare not go to C, or the breadth of a River or Water; that you cannot paſſe, or meaſure over it.

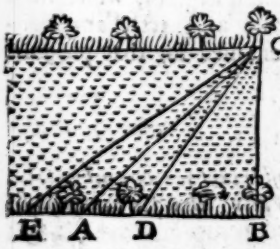
Standing upon the bank of the River at B, obſerve ſome marke againſt you on the farther ſide thereof as C, and ſo ſetting up a mark in the place where you ſtand at B, goe either to the right hand or left directly ſquire wiſe to theſe two markes, ſo far untill you eſpie the marke C on the further ſide doth juſtly make an angle of 45 degrees, with the mark B where you ſtood laſt, and this will be when youcome to A. And now in this caſe having been careful to do this exactly) you need do nothing but meaſure the diſtance, between your 2 ſtations B & A, and that ſhall be equal to the breadth of the River: So that if the one be 10, 20, 30, 40, or 100 poles, the



other is alſo juſt as much. The like you may do though the angle be any other degree, either more or leſſe then 45, but this is the beſt and readieſt angle to find out ſuch a diſtance: and therefore when you can uſe this, I would wiſh you to uſe no other.

The like alſo you may do at Sea, and thereby gain the diſtance of any Iſland, Cape, or Head-land from you, which you eſpie by chance as you are ſayling upon your courſe: without any altering of your courſe at all.

As if your courſe were Eaſt and Weſt between A and B, and between A and B, and being at B, you ſpie land at C, lying juſt at right angles with your courſe, keep a good account of your way till you come to A, where you obſerve the ſaid place C to make juſt an angle of 45 with your paſſed courſe B A, and ſo the diſtance of your way ſayled between theſe two places, ſhall be the true diſtance of the place C from the firſt place of obſervation B.



The work is all one, though in ſayling it is moſt likely that the firſt place of your obſervation will be at A, where you obſerve the place C to lie 45 degrees from your courſe A B, and afterward coming to B, you find there it lyes juſt at right angles from you, for ſo your diſtance ſayled from A to B, is equal to the diſtance from B to C.

And if you would have the ſloaping diſtance A C, turn to the angle of 45 deg. and there finding your diſtance ſayled in the margent, the Secant thereof will ſhew you the ſaid ſlope line. Thus if the diſtance ſayled A B be 10 Centeſmes or miles, the diſtance from A to C is 14.14, that is 14 Centeſmes or miles and 14 hundred parts more.

Prop.

Propoſition 12.

To find a diſtance by obſerving the angles upon which the thing lyes from you at any two places, one whereof ſhall be a right angle.

It may ſometimes ſo fall out, that either for want of room upon the land, or want of day light upon the water; you cannot obſerve the place at the right angle, and the angle of 45 degrees, as aforeſaid. In this it will be your beſt way to let the one of your obſervations be at the right angle, and the other as your conveniency will ſerve either above or under 45 degrees, onely it is good to let the diſtance you take be as much as you can, (I mean ſo) that the angle need not fall too much neerer then 45 degrees, the which in this caſe you need not exceed, unleſſe ſometimes you have let ſlip the time of your obſervation at 45 degrees, before you are aware, and ſo you may make uſe of any angle rather then looſe your pains in the former obſervation.

In this caſe the worke will not be much more then the former, is being onely the reſolution of a right angled triangle, which you ſhall performe by this rule.

As the Radius or Tangent of 45 degrees,
To the diſtance ſayled;
So is the Tangent of the acute angle obſerved,
To the diſtance from the right angle obſerved.
And ſo is the Secant of the acute angle,
To the diſtance from the acute angle.

Thus the angle at D being 56 deg. or five rumbs from the courſe, and the diſtance ſayled from B to D being 10 Miles,

Miles or 10 Centeſmes, which is two leagues and the diſtance C B and C D is required. Look in the tables for the angle of 36 deg. and againſt 10 in the margent you ſhall find the Tangent thereof is 14.83, that is almoſt 15 Miles, or 15 Centeſmes, which is 3 leagues, and this is the diſtance B C; And the Secant of this angle is 17.88, that is almoſt 18 Miles or Centeſmes; which is the diſtance D C.

The like manner of work it will be, if the place of the acute angle were beyond the angle of 45 degrees as at E, or at what angle ſoever it happens: but as I ſaid you need not goe beyond the place of the angle of 45, for thereabouts is as good a diſtance as you can chooſe.

A good way to meaſure inacceſſible heights.

And either of theſe two wayes you may obſerve likewiſe an altitude which you cannot or dare not come neer; for if you obſerve a time when the ſhadow is 2, 3, or 4 times the height of a thing, and obſerve at that inſtant where extremity of the ſhadow doth lye, make that place the Station of your right angle, and goe from that place ſquire wiſe either to the right hand or left, till you come to an angle of 45 deg. or any other angle thereabouts, ſo yon ſhall find as before the true length of the ſhadow, and by that the true height, better then by going backward from the the place according to the ordinary way, as was ſhewed before in the 2 Propoſition.

Propoſition 13.

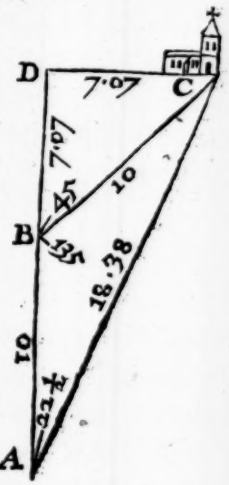
By the way of your ſhip, and any two angles of Poſition to find the diſtance of any Iſland, Caps, or Head land from you.

If you cannot with any conveniency bring the place eſpied by you to a right angle, yet you may doe the buſineſſe with a little more trouble by any two angles whatſoever, wherein firſt I ſhall ſhew you the ordinary way and how you may help your ſelfe herein.

The

The ordinary way is to take any two angles at randome, provided the diſtance ſayled between the two obſervations be any thing conſiderable to the diſtance of the place deſired.

As thus, ſuppoſe you were ſayling from A toward B full North, and being at A ſhould eſpie a land mark at C, bearing from you *N N E*, or *N E* 22 deg. ½. And ſayling ſtill on your courſe to B about 10 miles, ſhould obſerve the ſaid places C to bear full *N E* or 45 deg. and by theſe two obſervations, you would know the diſtance of the place C, from B, or A, or both, and alſo from the place of the right angle at D.



Here you have the oblique triangle A B C to reſolve in which you have the angle at A 22 deg. ½. Then the obtuſe angle at B 135, being the complement of the acute at B, which was 45 to 180. And thirdly, you have the angle at C, which is the complement of both the aforeſaid angles at A and B to 180, being 22 deg. ½ And laſtly, you have the ſide of diſtance ſayled A B, which is 10 miles.

180	
45	
135	
135	
22½	
157½	

Therefore as the ſine of the angle at C 22 deg. ½,
To the ſide oppoſed thereto, A B 10 miles;
So is the ſine of either of the other angles,
To their oppoſite ſides.

To performe this by theſe tables, turn to the Sine of 22 deg. ½, and look down the column of the Coſine 67 degrees.

grees $\frac{1}{2}$, (becauſe theſe columns are tranſpoſed) until you find your number of miles, which is 10, which will be againſt 26 in the margent (if you allow the proportional part) mark this line in which you find it: Now turn to the other angle at B, which is 135 degrees, whoſe complement is 45 degrees, and there in the 26 line of that leafe, you ſhall find 18.38, which ſhewes you the length of the line A C being 18 miles $\frac{38}{100}$ parts.

The like you might do for the other ſide B C, which here will fall out to be the ſame with A B; And having either of theſe ſloap ſides, A C, or B C, you may either by the firſt caſe of Triangles, or the firſt Propoſition of this Chapter find the ſides of the right angle C D and D B or D A.

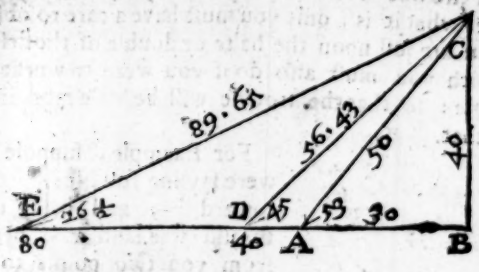
Propoſition 14.

To performe the ſame thing by two like angles of poſition more fitly choſen for the purpoſe.

In the eighth Propoſition, I ſhewed you how to find out ſuch an angle as would make the ſhadow of any perpendicular to be 1, 2, 3, 4, 5, or more times the length thereof. And the like you may do by the *Quadrat*. Now if you make your obſervation of the poſition of ſuch a place as this, at two ſuch angles as ſhall agree to this *Quadratical* or right angle diſtance, you may then reſolve your triangle by the rules of a right angled triangle.

Thus, if you firſt obſerve at E, when the place C doth bear from the line of the courſe B E 26 degrees $\frac{1}{4}$, (at which angle the tangent is twice the length of the Radius and then again watch the time when the place C makes an angle of 45 degrees from the courſe as at D, (at which angle the tangent is once the length of the Radius) it muſt neeeds then follow, that the diſtance ſayled between E and D, is equal to the diſtance at the right C B, which if you make the Radius, the lines C D and C E will be the

Se-



Secants of the complements of the angles obſerved at D and E.

Thus the diſtance ſayled between E and D being 4 leagues or miles, and this being equal to the Radius C B, turn to the angle obſerved at D 45 deg. and againſt 4 in the margent the Secant is 5.65, likewiſe turn to the angle obſerved at E being 26 deg. ½, and againſt 4 in the margent, the Secant of the complement is 8.98 parts. And thus you have the diſtance of the place C, from all theſe three places E D and B, and thus knowing the Radius C B, you may know the diſtance from it at any other angle,

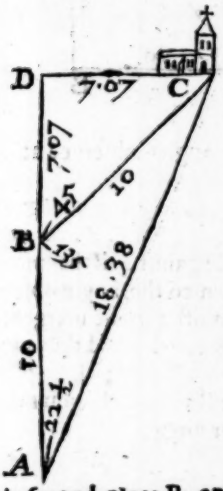
Propoſition 15.

To performe the ſame thing by two angles choſen ſomewhat more readily.

The beſt and moſt ready way to performe this, is by taking two ſuch angles, that the angle at the ſecond Station ſhall be either juſt the double, if you goe neerer, or elſe juſt the halfe, if you goe farther off then the angle at the firſt place. By this means the calculation will be moſt eaſily performed, and there willl be litle trouble in the obſervation

This Propoſition is of excellent and ready uſe in many occaſions, though it hath not been obſerved by any, but only to work it all out by calculation.

tion, for the one of the angles you may take at randome, no matter what it is, only you muſt have a care to obſerve when you are juſt upon the halfe or double of the firſt angle; which you muſt alſo do if you were to worke by a right angle: ſo that the trouble will be little more in this then in that.



For Example, ſuppoſe you were ſayling full North from A toward B, and being at A ſhould eſpie land at C, bearing from you two points to the Eaſtward *viz.* *N N E*, or *N E* 22 deg. ½, and ſayling ſtill upon your courſe till you come to B, you there obſerve that the ſame place beares from you juſt 4 points, or full *N E* 45 deg. which is juſt double to the angle you obſerved at A. If you ſhould do no more then thus, yet by this you may aſſure your ſelfe that the diſtance you have ſayled between A and B is juſtly equal to the diſtance between this ſecond place B, and C the place obſerved: So that if A B be 10 miles, or Centeſmes B C is likewiſe 10 miles or Centeſmes.

That this muſt needs be thus is plain; for in the triangle A B C the acute angle or outward angle at B being 45 deg. the obtuſe and inward angle being the complement thereof to 180, muſt be 135 deg. and the angle at A being 22 deg. ½; being added to this, makes 157 deg. ½, which ſubſtracted from 180, there muſt needs reſt for the angle at C 22 deg. ½. Now this angle at C, being equal to the angle at A, which was 22 deg. ½ alſo, therefore the ſide A B oppoſed to the one, muſt needs be equal to the ſide B C, op-

oppoſed to the other. So that the diſtance ſayled from A to B, is equal to the diſtance from B to C, and upon this account may be known without any farther trouble or calculation.

And this falls out not onely thus in this angle, but in any other, as you may ſee in the 3 propoſition: and you may eaſily try it in any other angle. So that let your firſt angle be what it will, you need not much care, onely watch when you bring the place to the double, or halfe at the ſecond place of obſervation, as you go neerer, or farther from the place.

Thus in approaching to a place.		Or in going from a place.	
The firſt angle obſerved being	The ſecond obſervation muſt be	The firſt angle obſerved being	The ſecond angle muſt be
½ a point.	1 point.	8 points.	4 points.
1 point.	2 points.	4 points.	2 points.
2 points.	4 points.	2 points.	1 point.
4 points.	8 points.	1 point.	½ point.

The ſame is true alſo in the degrees of the *Quadrant*, and holds good though you paſſe the right angle.

The firſt.	The ſecond.	The firſt.	The ſecond.
1 degree.	2 degrees.	160 degrees.	80 degrees.
2 degrees.	4 degrees.	80 degrees.	40 degrees.
4 degrees.	8 degrees.	40 degrees.	20 degrees.
8 degrees.	16 degrees.	20 degrees.	10 degrees.
16 degrees.	32 degrees.	10 degrees.	5 degrees.
32 degrees.	64 degrees.	5 degrees.	2 deg. ½
64 degrees.	128 degrees.	2 deg. ½	1 deg. ¼

And now if you would know how far A the other place of your obſervation, is diſtant from C, you may do it ſeveral wayes.

As firſt in the triangle A B C: you have the ſide A B which is the diſtance you have ſayled, which ſuppoſe to be 10 miles or Centeſmes, and the ſide B C which is equal thereto, and all the three angles; therefore by the oppoſition of ſides and angles you may find the ſide A C to be 18 miles or centeſmes, and 38 parts, as I ſhewed before in the 13 Propoſition of this Chapter.

But it will be the better way if you find the Radical diſtance, or diſtance D C, at the right angle, ſo you ſhall afterward readily find the diſtance of the place at any other angle.

And this Radical diſtance is thus found out, for here you have ſlope line or Hypothenuſal B C, and the angle at B 45, and therefore according to the firſt caſe of triangles, turn to the angle 45, and there againſt the length of your ſlope ſide 10 miles or centeſmes, you ſhall find the 2 columns of Sines giving you for the 2 ſides 07.07 (which here fall out to be both equal) this 07.07 parts is your Radius C D, and now the Secant of the complement of any angle obſerved, will give the diſtance thereof.

Thus the angle at A being 22 deg. ½, turn to this angle, and if you uſe the proportional part, for the parts of the degree, and the parts of the number, you ſhall find the Co-ſecant for this diſtance and angle to be 18.38 parts, as before.

And thus you may find the true diſtance of any other place, from this place C, by the angle obſerved at the ſaid place, as long as you are in ſight thereof, keeping your way ſtill upon the ſame courſe.

Prop.

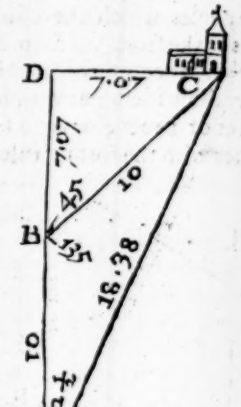
Propoſition 16.

Knowing the diſtance between two places on the land, and how they bear one from the other, and having their angles of poſition at the ſhip, to find the diſtance of your ſhip from either of them.

This Propoſition is laid down, and thus reſolved by Mr. *Gunter*, in the end of his croſſe ſtaffe.

But the beſt way to obſerve, is to bring one of the places to a right angle, as if the places lye Eaſt and Weſt, to bring one of them North or South of your ſhip: ſo you ſhall have a right angled Triangle, whoſe three angles and one of the ſides are known, which he ſhewes how to reſolve by Sines; but it is better to do it by the Tangents and Secants making the diſtance between the two places your Radius.

Let the two places be D and C, which lye Eaſt and Weſt, and the diſtance between them 7 miles 7 parts, and let the ſhip be at A, and the angle obſerved between D and C 22 deg. $\frac{1}{2}$.



Turn to this angle of 22 deg. or 23 deg. and againſt 15 in the margent the Co-tangent or ſide D A is 17.07 parts, and the Co-ſecant or ſide A C is 18.38 parts.

In this caſe you may much helpe your ſelfe with the two former Propoſitions, for though it be hard to meet with two land marks in ſuch an fit poſition, yet by any ſingle land mark you may find the Radical diſtance, between any place upon the land, and your ſhips way,

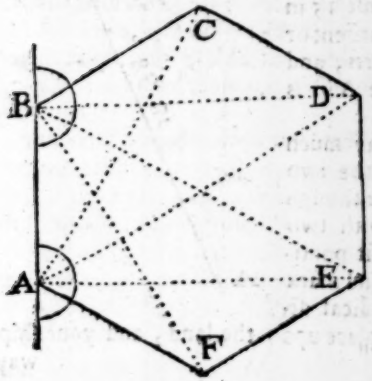
way, which being known, the work is all one with this, and by the angle of poſition at any time, you may know the diſtance of your ſhip, and ſo what ſpeed you make either to or from your part or Port eſpied.

Propoſition 17.

To take the plat of a Port, City, Coaſt, or Countrey.

All that I have ſaid before, hath been chiefly to prepare and fit you for theſe following propoſitions, wherein you may have occaſion to uſe many or the moſt of them, and therefore having been ſo plain and large before, I ſhall be ſomewhat the briefer now, onely mentioning them, or referring to them.

It may be ſufficient for the Sea-mans uſe in taking the plot of a Port, City, Coaſt, or Countrey, only to obſerve the angles which the chiefe buildings, capes, points or rivers make from his ſhip at two ſeveral places; and ſo by the diſtance of thoſe two places of his obſervation, he may draw them out with his Ruler and Compaſſes upon a ſheet of paper, or if he ſee fit may helpe himſelfe: ſometimes with the former rules.



Let the two places of obſervation be A and B, being juſt North and South, being diſtant 5 miles or leagues, or 50 poles and the angles from the ſaid two places, according to obſervation as followeth.

The

The angles taken at A.		The angles obſerved at B.	
A B *North*	00.00	B C *N. Eaſt*	60 deg.
A C *N. Eaſt*	30 deg.	B D *Eaſt*	00.00
A D *N. Eaſt*	60 deg.	B E *S. Eaſt*	60 deg.
A E *Eaſt*	00.0	B F *S. Eaſt*	30 deg.
A F *S. Eaſt.*	60. deg.	B A *South*	00.00

I hope I need not tell you the manner how to obſerve theſe angles, you may do it either by a Theodolite or a Circumferentor, or Peractor, or by your Compaſſe, or by the Croſs ſtaff obſerving every angle or eminent mark, as Houſe, Church Tree, &c. from the place next unto it, and by theſe angles thus obſerved you may ſet down the plot thereof in paper to any largeneſſe you pleaſe.

But the beſt and readyeſt way to do it, is by a Plain Table fitted for the purpoſe, or you may make ſhift with a ſheet of paper, after the manner of the Plain Table. Wherein firſt taking a Center point at A, and laying a ruler with ſights thereto, turn it about to the ſeveral places B C D E F, and draw lines from A to either of thoſe marks. Then being come to your ſecond Station B, lay down your paper againe, and taking a convenient Scale for your diſtance ſet it off in the line A B, according to the diſtance of your two Stations, make B your Center point; and laying your ruler thereto, turn it ſo that it may lye juſt upon the line B A, and keeping your Ruler there: turn it, and the Table or paper altogether, till you ſee the place of your firſt Station A, by the ſights upon your Ruler; and having ſo done keep your Table fixed there, but turn your Ruler backward againe to the ſeveral places F E D C, and draw the lines thereby, Now the chief thing is to marke where theſe lines laſt drawn from the Station at B, croſſe the lines which were drawn before, from the Station at A, which is in the ſaid points C D E F;

C D E F; and theſe croſſings will ſhew the module or the poſition, and diſtance of all theſe places each from other, ſo that you may meaſure the diſtance of any of them, if you divide the line A B between the two center points, according to the Scale of diſtance, by which you ſet off your two Stations each from other: And this will be exact enough for the Sea-mans purpoſe.

And thus if you will not be too curious, if your inſtruments are any thing large, and ſo well fitted for the purpoſe, ſo that you may be well aſſured of the exactneſſe of the angles; then by the ſide known A B, and the angles obſerved at thoſe two Stations, you may find out the length of any of the lines, and ſo either with your Compaſſes, or by theſe tables bring it into a leſſer or a greater Compaſſe: or if it be a piece of land to be meaſured, you may bring it into Triangles or Trapeziums, and find the length of the lines and ſo caſt up the contents thereof.

Propoſition 18.

A more exact method for the true Surveying of any parcil of Land whether great or ſmall.

Hitherto I have taught the Sea-man ſome things of the Art of Surveying; now I ſhall teach the Surveyour ſomewhat of the Sea-mans practice, and that is how he ſhall order his accounts by theſe Traverſe Tables, reckoning by latitude and longitude as the Sea-man doth, whereby he ſhall performe his work more readily and exactly then by any other inſtrument: obſerving theſe following direction.

1. *For the ordering of your worke in the field.*

When you have any parcel of land to meaſure, you muſt meaſure the bounds thereof round about ſide by ſide, from angle to angle, obſerving exactly either by your Needle,

Needle, Compaſſe or other inſtrument fit for the purpoſe how the ſaid ſides lye at each angle: and this you muſt ſet down in ſome Book or Table fitted for the purpoſe, being divided into ſeveral columns as you ſee this following. And herein it will be beſt to begin at ſome angle which lyes moſt North Weſterly or South Weſterly, that ſo the latitude and longitude may fall in the better order in your Table, without too often altering your work from Addition to Subſtraction. And this is all you need do in the field, onely for your better direction and memory, you may with your pen at randome draw any little plot thereof, as neer the truth as you can, to which you may adde ſuch obſervations concerning the bounds thereof, as are neceſſary to be obſerved. This way of meaſuring the ſides and angles, is the beſt for all manner of grounds or parcels of land, great or ſmall, whether they be little and plain fields, ſo that you may meaſure them on the inſide, and ſee over them from ſide to ſide: or whether they be large and covered Forreſts, Parkes, or Woods, which you cannot ſee over or through.

2. *How to make a Table which ſhall ſhew you the difference of latitude and longitude, of all the angles from your firſt Station, and alſo from any of the other Stations.*

Having done your work in the field, and being come into the houſe or place convenient, look over your notes and according to the angles of poſition and lengths of the ſeveral ſides, find out by theſe Tables the difference of their Northing and Southing, Eaſting and Weſting of the ſeveral angular points one from the other. And this you muſt ſet down in your book or table provided for that purpoſe in this forme following. And in the two laſt columns you may ſo adde or ſubſtract the other four columns together, (ſtill reckoning the line following to the former ſums,) that they may ſhew the true difference of longitude

and latitude of any of the ſaid points, from your firſt choſen point A, as if that were the firſt Meridian, under the the Equinoctiall: and this alſo with a little more trouble, will give you the difference of longitude and latitude, from any of the other points alſo, as by the Tables of the longitude and latitude of places, you find their difference of longitude and latitude: by the which alſo according to the rules of * Plain ſayling aforeſaid, you may come to find the true Poſition and diſtance of any of the ſaid angular points or Stations each from other.

* See the Chapter of *Plain ſayling.*

And though few parcels of land thus to be meaſured extend ſo far as to be accounted in degrees of longitude and latitude, in reſpect of the Globe of the Earth, (as the Seaman many times hath occaſion to reckon) one degree thereon conteining above 36000 poles, yet this is alſo true longitude and latitude, and may fitly be ſo called, though in never ſo ſmall quantity, and meaſured by any meaſures, as Chains, Poles, Yards, Feet or Inches.

The Stations.		Poſition Deg.	Diſtãce pol.	pts.	*North* po.	pts.	*South* po.	pts.	*Eaſt* po.	pts.	*Weſt* po.	pts.	Latit. pol.	pts.	Longit. pol.	pts.
The firſt	A													0		0
	A to B	*NE* 20	80		0 75	18			27	36			75 *N*	18	29 *E*	36
	B to C	*N E* 80	80		0 13	89			78	78			69	07	106	14
	C to D	*S E* 40	30		0		61	28	51	42			27	79	157	56
from	D to E	*W* 20	80		0		75	18			27	36	47 *S*	39	130	20
	F to F	*SW* 80	80		0		13	89			78	78	61	28	51	42
	F to G	*NW* 40	80		0 61	28					51	42		0		0
			150	35	150	35	157	56	157	56						

3 *How*

3. *How to prove your worke, whether you have taken the true meaſure of all the ſides and angles of the Plot, or not.*

This is a tuing very neceſſary to be known, before you proceed any farther, and this will readily be found out by the foreſaid Table theſe two wayes.

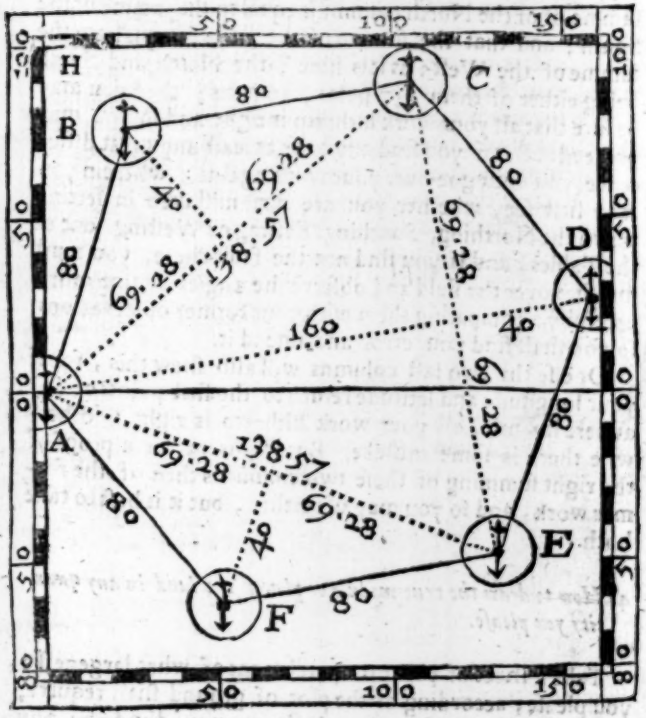
Firſt, if you caſt up the four middle columns of the Table, intitled North, South, Eaſt, Weſt, and find that the ſumme of of the North column, is equal to the ſumme of the South; and that the ſumme of the Eaſt, is equal to the ſumme of the Weſt; as it is here; the North and South being either of them 157 poles, 56 parts; then you may be ſure that all your work hitherto is right and ſo you may proceed. But if you find any, or at leaſt any great difference, you muſt goe over your work againe: wherein you may firſt ſee, whether you are not miſtaken in ſetting down the Northing, Southing, Eaſting or Weſting, out of the Tables, and if you find not the fault there, you muſt meaſure over the field and obſerve the angles againe more carefully, comparing them with your former obſervations. ſo you ſhall find your error and amend it.

Or elſe the two laſt columns will alſo ſhew this, for if your longitude and latitude return to the firſt points or (o) as here it doth, all your work hitherto is right: otherwiſe there is ſome miſtake. But this is rather a proof of the right ſumming of theſe two columnes then of the former work, and ſo you may uſe either, but it is beſt to take both.

4. *How to draw the true module or plot of the land in any quantity you pleaſe.*

Take a ſheet of paper or parchment of what largeneſſe you pleaſe, according as the plot of ground ſhall require, and draw a ſquare about it, which you may divide by any

Scale of equal parts, but the quantity of one inch will ſerve very well for ten Poles or Chains in a large map, and for 100 in a leſſer, for though ſometimes it be deſired by the Lords or owners to have an handſome plot of their gounds in theſe larger ſizes, yet it is not neceſſary to the true caſting up of the contents thereof, that may be done by theſe Tables, and any little ſcheam or draught thereof, as well by one which is an hundred times greater, the ordinary way by the Scale and compaſſe.



Ha-

Having therefore determined your Scale, according to your occaſion, and divided and numbred by your ſquare accordingly; ſet down therein the ſeveral angular points A B C D E F, according to their longitude and latitude from the firſt point A, according to the rules of the Plain Chart.

Thus having choſen a fit place where the point A ſhould ſtand, let B be placed from it 75 poles, 18 parts Northward, and 27 poles, 36 parts, Eaſtward: which you may do by laying a ruler firſt to the latitude thereof in the ſides of the Table, and drawing a ſmall occult line, and then laying your ruler to the top and bottom of the ſquare, at the longitude thereof, croſſe the foreſaid line; and that is the point of the angle B. So you muſt doe for the points C D E F, according to their longitude and latitude in the Table, and then draw the lines from A to B, from B to C, and ſo round about till you come to A againe, and thus you have the true form of the bounds of the ſaid Field, Wood, Park or Forreſt, which you would meaſure. In the further particulars whereof the draught it ſelfe will will direct you better then many words.

5 *How to caſt up the content of any parcel of land in Poles and Acres.*

My intent here is not to ſhew you how to meaſure any parcel of land according to the forme it lyes in, whether it be circular, ſquare, or triangular, &c. but having the plot of the field before you, caſt it into ſome regular forme (which commonly will fall into Triangles or Trapeziums) making as few parcels thereof as you can: And knowing all the ſides which bound the field, and the angles thereof, if you would know the true quantity of any other ſide or angle neceſſary for the caſting up of the contents, you may find it out either by the Doctrine of Plain Triangles, or by the rules of Plain Sayling, and thus caſting up the contents of the ſeveral parts, and adding them toge-

together, the total ſumme will be the true content of the parcel of land.

For example, though this be a regular Hexagon, and the contents might be found out a neerer way, yet for example ſake, I ſhall divide it into four Triangles from the point A, by the lines A C, A D and A E, and moſt of the angles of theſe Triangles are known, if you obſerve the poſition of the places from each other and make Subſtraction according to the angles before and after.

But when you cannot readily find the angles this way, you may make uſe of the rules of plain Sayling, and by the difference of longitude and latitude of any two places, find out the angle of their Rumb, and the diſtance between them. As now in the Triangle A B C, if you would find the angle at A, and the diſtance A C. Firſt, find the difference of longitude and latitude of C from A, which the Table ſhews you, being North from A 89 poles, 07 parts, and Eaſt 106 poles 14 parts.

Now as the difference of latitude	89.07
To the difference of longitude	106 14
So is the Radius or Tangent of 45	10000
To the tangent of the angle from the merid.	119.17

Which is the tangent of 50 degrees.

Againe as the Radius or	100.00
To the difference of latitude	89.07
So is the Secant of this angle 50 degrees.	155.57
To the ſecant or ſide A C	138,57

By theſe three ſides now, B C 80 poles, B C 80 poles, and A C 138 poles 57 parts, you may find the content of the triangle by the tables of Logarithmes, but it is better to let fall the perpendicular from B upon this line A C, which thus you may do.

The

The whole angle H A C being found to be 50 degrees,
The angle H A B to be ſubſtracted 20 degrees,
There remains for the angle B A C 30 degrees,
Now as the Radius 100,00
To the ſide A B 80 poles, 80
So the Sine, (or rather Coſine) of the angle 30 deg.
To the perpendicular 80 poles 40

And now the ſide A C 130 poles 57, multiplyed by halfe this perpendicular; yields 2771 poles 40 parts, which is the content of the ſaid triangle.

So likewiſe in the triangle A C D, the ſide A C was found in the laſt triangle to be 138.57, the ſide C D is 80 poles, and for the ſide A D and the angle at A, you may find it as before, by the Northing and Eaſting of D from A, which is North 27.79, and Eaſt 157.56 parts: which gives the whole angle H A D 80 degrees, and the ſide A D 160 poles. Now if you take the angle H A C 50 degrees, from this 80 degrees there remains for this angle 30 degrees, by which angle 30 degrees, and the ſide A C 138.37 parts, you will find the perpendicular from C to be 69.28 parts, and this multiplied by the halfe of the ſide A D which is 80 poles, yields for the content 5542 poles, 40 parts.

The like you may do for the other two triangles A D E, and A E F, which are like to the two former, ſo that it is needleſſe to go over the ſame againe: and much of this labour might be ſpared alſo, if when you are in the field you obſerve thoſe angles round about from the place A; For that is the moſt troubleſome part of the worke; the ſides being eaſily found by the Secants, and the perpendiculars by the Sines, which you may performe by theſe Tables, either by turning to the angles, where you ſhall find your numbers ready caſt up to your hand, or at moſt you may take it out at twice, and adde them together.

In the laſt place for the content of the whole field, you muſt adde all theſe ſeveral triangles together, and divide the

the product by 160 poles, ſo you ſhall bring it into acres; Thus,

	poles	parts
The content of the triangle A B C is	2771	40
The content of the triangle A C D is	5542	40
The content of the triangle A D E is	5542	40
The content of the triangle A E F is	2771	40
The ſumme of all is	16627	60

Which divided by 160 poles, the content of one acre, yields 103 acres, 147 poles, 60 parts, or 103 acres, 3 quarters, or 3 roods, 27 poles, 60 parts.

Laſt of all as you doe here by one large field, parting it into ſeveral parcels, and ſo meaſure it; So you may do by a great Lordſhip or Manor, which hath ſeveral fields and parcels of land belonging to it. Firſt, meaſure the bounds thereof round about, and lay down the plot thereof. Then meaſure the bounds of the ſeveral fields, and ſet them down in your Plot, and thereby you ſhall by ſome few of the lines and angles, find the content of the ſeveral fields; and adding them all together, know the content of the whole Manor, and deſcribe a true Plot thereof.

But of theſe things I onely give you a ſhort view, they being ſomewhat beſide my intended purpoſe, yet I hope this will be enough to inſtruct you how to take the true Plot of any Sea Coaſt, Port, or Iſland, as you ſayle along by it upon the Sea, or if need be to deſcribe any Countrey you ſhall have occaſion to land upon; which may be of great uſe, eſpecially when you diſcover any ſuch places as are not yet found out, or fully and truly deſcribed in your Maps and Charts.

FINIS.

THE SEA-MANS CANON OF TRIANGLES OR,

New Tables of Sines, Tangents, and Secants in Natural Numbers, to any Radius desired.

Briefely and plainly resolving all Cases of Right lined Triangles, (Instrumentally) by looking upon the Tables, without any Calculation.

By HENRY PHILLIPPES.

LONDON
Printed by *R & W. Leybourn* for *George Hurlock* and are to be sold at his shop at *Magnus* Church-corner. 1657.

Numbers	Sines Degrees 1		Sines Degrees 89		Tangents Degrees 1		Tangents Degrees 89		Secants Degrees 1		Secants Degrees 89		Numbers
	N.	pt	N.	pt	N.	pt.	N.	pts.	N.	pt	N.	pts.	
1	01	00	00	02	0	02	057	30	1	00	057	30	1
2	02	00	00	04	0	04	114	60	2	00	114	60	2
3	03	00	00	05	0	05	171	90	3	00	171	90	3
4	04	00	00	07	0	07	229	20	4	00	229	20	4
5	05	00	00	09	0	09	286	50	5	00	286	50	5
6	06	00	00	10	0	10	343	80	6	00	343	80	6
7	07	00	00	12	0	12	401	10	7	00	401	10	7
8	08	00	00	14	0	14	458	40	8	00	458	40	8
9	09	00	00	16	0	16	515	70	9	00	515	70	9
10	10	00	00	18	0	18	573	00	10	00	573	00	10
11	11	00	00	19	0	19	630	30	11	00	630	30	11
12	12	00	00	21	0	21	687	60	12	00	687	60	12
13	13	00	00	23	0	23	744	90	13	00	744	90	13
14	14	00	00	24	0	24	802	20	14	00	802	20	14
15	15	00	00	26	0	26	859	50	15	00	859	50	15
16	16	00	00	28	0	28	916	80	16	00	916	80	16
17	17	00	00	30	0	30	974	10	17	00	974	10	17
18	18	00	00	31	0	31	1031	40	18	00	1031	40	18
19	19	00	00	33	0	33	1088	70	19	00	1088	70	19
20	20	00	00	35	0	35	1146	00	20	00	1146	00	20
21	21	00	00	37	0	37	1203	30	21	00	1203	30	21
22	22	00	00	38	0	38	1260	60	22	00	1260	60	22
23	23	00	00	40	0	40	1317	90	23	00	1317	90	23
24	24	00	00	42	0	42	1376	20	24	00	1376	20	24
25	25	00	00	44	0	44	1432	50	25	00	1432	50	25
26	26	00	00	45	0	45	1489	80	26	00	1489	80	26
27	27	00	00	47	0	47	1547	10	27	00	1547	10	27
28	28	00	00	49	0	49	1604	40	28	00	1604	40	28
29	29	00	00	51	0	51	1661	70	29	00	1661	70	29
30	30	00	00	52	0	52	1719	00	30	00	1719	00	30
31	31	00	00	54	0	54	1776	30	31	00	1776	30	31
32	32	00	00	56	0	56	1833	60	32	00	1833	60	32
33	33	00	00	58	0	58	1890	90	33	00	1890	90	33
34	34	00	00	59	0	59	1948	20	34	01	1948	20	34
35	35	00	00	61	0	61	2005	50	35	01	2005	50	35
36	36	00	00	63	0	63	2062	80	36	01	2062	80	36
37	37	00	00	65	0	65	2120	10	37	01	2120	10	37
38	38	00	00	66	0	66	2177	40	38	01	2177	40	38
39	39	00	00	68	0	68	2234	70	39	01	2234	70	39
40	40	00	00	70	0	70	2292	00	40	01	2292	00	40
41	41	00	00	72	0	72	2349	30	41	01	2349	30	41
42	42	00	00	73	0	73	2406	60	42	01	2406	60	42
43	43	00	00	75	0	75	2463	90	43	01	2463	90	43
44	44	00	00	77	0	77	2521	20	44	01	2521	20	44
45	45	00	00	78	0	78	2578	50	45	01	2578	50	45
46	46	00	00	80	0	80	2635	80	46	01	2635	80	46
47	47	00	00	82	0	82	2693	10	47	01	2693	10	47
48	48	00	00	84	0	84	2750	40	48	01	2750	40	48
49	49	00	00	86	0	86	2807	70	49	01	2807	70	49
50	50	00	00	87	0	87	2865	00	50	01	2865	00	50

Numbers	Sines Degrees 1 N.pt	Sines Degrees 89 N.pt.	Tangents Degrees 1 N.pts	Tangents Degrees 89 N. ptr.	Secants Degrees 1 N.pts.	Secants Degrees 89 N. pts	Numbers
51	51 00	0 89	0 89	2922 30	51 01	2921 30	51
52	52 00	0 91	0 91	2979 60	52 01	2979 60	52
53	53 00	0 93	0 93	3036 90	53 01	3036 90	53
54	54 00	0 94	0 94	3094 20	54 01	3094 20	54
55	55 00	0 96	0 96	3151 50	55 01	3151 50	55
56	56 00	0 98	0 98	3208 80	56 01	3208 80	56
57	57 00	0 99	0 99	3266 10	57 01	3266 10	57
58	58 00	1 01	1 01	3323 40	58 01	3323 40	58
59	59 00	1 03	1 03	3380 70	59 01	3380 70	59
60	60 00	1 05	1 05	3438 00	60 01	3438 00	60
61	61 00	1 06	1 06	3495 30	61 01	3495 30	61
62	62 00	1 08	1 08	3552 60	62 01	3552 60	62
63	63 00	1 10	1 10	3609 90	63 01	3609 90	63
64	64 00	1 12	1 12	3667 20	64 01	3667 20	64
65	65 00	1 13	1 13	3724 50	65 01	3724 50	65
66	66 00	1 15	1 15	3781 80	66 01	3781 80	66
67	67 00	1 17	1 17	3839 10	67 01	3839 10	67
68	68 00	1 19	1 19	3896 40	68 01	3896 40	68
69	69 00	1 20	1 20	3953 70	69 01	3953 70	69
70	70 00	1 22	1 22	4011 00	70 01	4011 00	70
71	71 00	1 24	1 24	4068 30	71 01	4068 30	71
72	72 00	1 26	1 26	4125 60	72 01	4125 60	72
73	73 00	1 27	1 27	4182 90	73 01	4182 90	73
74	74 00	1 29	1 29	4240 20	74 01	4240 20	74
75	75 00	1 31	1 31	4297 50	75 01	4297 50	75
76	76 00	1 33	1 33	4354 80	76 01	4352 80	76
77	77 00	1 34	1 34	4412 10	77 01	4412 10	77
78	78 00	1 36	1 36	4469 40	78 01	4469 40	78
79	79 00	1 38	1 38	4526 70	79 01	4526 70	79
80	80 00	1 40	1 40	4584 00	80 01	4584 00	80
81	81 00	1 41	1 41	4641 30	81 01	4641 30	81
82	82 00	1 43	1 43	4698 60	82 01	4698 60	82
83	83 00	1 45	1 45	5755 90	83 01	4755 90	83
84	84 00	1 47	1 47	4813 20	84 01	4813 20	84
85	85 00	1 48	1 48	4870 50	85 01	4870 50	85
86	86 00	1 50	1 50	4927 80	86 01	4927 80	86
87	87 00	1 52	1 52	4985 10	87 01	4985 10	87
88	88 00	1 54	1 54	5042 40	88 01	5042 40	88
89	89 00	1 55	1 55	5099 70	89 01	5099 70	89
90	90 00	1 57	1 57	5157 00	90 01	5157 00	90
91	91 00	1 59	1 59	5214 30	91 01	5214 30	91
92	92 00	1 60	1 60	5271 60	92 01	5271 60	92
93	93 00	1 62	1 62	5328 90	93 01	5328 90	93
94	94 00	1 64	1 64	5386 20	94 01	5386 20	94
95	95 00	1 65	1 66	5443 50	95 01	5443 50	95
96	96 00	1 67	1 67	5500 80	96 01	5500 80	96
97	97 00	1 69	1 69	5558 10	97 01	5558 10	97
98	98 00	1 71	1 71	5615 40	98 01	5615 40	98
99	99 00	1 73	1 73	5672 70	99 01	5672 70	99
100	100 00	1 75	1 75	6770 00	100 02	5730 00	100

o Rumb and an half is 5 deg. 37 min. and an halfe.

Numbers	Sines Degrees 2		Sines Degrees 88		Tangents Degrees 2		Tangents Degrees 88		Secants Degrees 2		Secants Degrees 88		Numbers
	N.	pt	N.	pt	N.	pt.	N.	pts.	N.	pt	N.	pts.	
1	00	99	00	03	0	03	28	65	1	00	28	65	1
2	01	99	00	07	0	07	57	30	2	00	57	30	2
3	02	99	00	10	0	10	85	95	3	00	85	95	3
4	03	99	00	14	0	14	114	60	4	00	114	60	4
5	04	99	00	17	0	17	143	25	5	00	143	25	5
6	05	99	00	21	0	21	171	90	6	00	171	90	6
7	06	99	00	24	0	24	200	55	7	00	200	55	7
8	07	99	00	28	0	28	229	20	8	00	229	20	8
9	08	99	00	31	0	31	257	85	9	00	257	85	9
10	09	99	00	35	0	35	286	50	10	01	286	50	10
11	10	99	00	38	0	38	315	15	11	01	315	15	11
12	11	99	00	42	0	42	343	80	12	01	343	80	12
13	12	99	00	45	0	45	372	45	13	01	372	45	13
14	13	99	00	49	0	49	401	10	14	01	401	10	14
15	14	99	00	52	0	52	429	75	15	01	429	75	15
16	15	99	00	56	0	56	458	40	16	01	458	40	16
17	16	99	00	59	0	59	487	05	17	01	487	05	17
18	17	98	00	63	0	63	515	70	18	01	515	70	18
19	18	98	00	66	0	66	544	35	19	01	544	35	19
20	19	98	00	70	0	70	573	00	20	01	573	00	20
21	20	98	00	73	0	73	601	95	21	01	601	65	21
22	21	98	00	77	0	77	630	30	22	01	630	30	22
23	22	98	00	80	0	80	658	95	23	01	658	95	23
24	23	98	00	84	0	84	687	60	24	01	687	60	24
25	24	98	00	87	0	87	716	25	25	01	716	25	25
26	25	98	00	91	0	91	744	60	26	02	744	90	26
27	26	98	00	94	0	94	773	55	27	02	773	55	27
28	27	98	00	98	0	98	802	20	28	02	802	20	28
29	28	98	01	01	1	01	830	85	29	02	830	85	29
30	29	98	01	05	1	05	859	50	30	02	859	50	30
31	30	98	01	08	1	08	888	15	31	02	888	15	31
32	31	98	01	12	1	12	916	80	32	02	916	80	32
33	32	98	01	15	1	15	945	45	33	02	945	45	33
34	33	98	01	19	1	19	974	10	34	02	974	10	34
35	34	98	01	22	1	22	1002	75	35	02	1002	75	35
36	35	97	01	26	1	26	1031	40	36	02	1031	40	36
37	36	97	01	29	1	29	1060	05	37	02	1060	05	37
38	37	97	01	33	1	33	1088	70	38	02	1088	70	38
39	38	97	01	36	1	36	1117	35	39	02	1117	35	39
40	39	97	01	40	1	40	1146	00	40	02	1146	00	40
41	40	97	01	43	1	43	1174	65	41	03	1174	65	41
42	41	97	01	47	1	47	1203	30	42	03	1203	30	42
43	42	97	01	50	1	50	1231	95	43	03	1231	95	43
44	43	97	01	54	1	54	1260	60	44	03	1260	60	44
45	44	97	01	57	1	57	1289	25	45	03	1289	25	45
46	45	97	01	61	1	61	1317	90	46	03	1317	90	46
47	46	97	01	64	1	64	1346	55	47	03	1346	55	47
48	47	97	01	68	1	68	1375	20	48	03	1375	20	48
49	48	97	01	71	1	71	1403	85	49	03	1403	85	49
50	49	98	01	75	1	75	1432	50	50	03	1432	50	50

Numbers	Sines Degrees 2 N.pt		Sines Degrees 88 N.pt.		Tangents Degrees 2 N.pts		Tangents Degrees 88 N. pts.		Secants Degrees 2 N.pts.		Secants Degrees 88 N. pts		Numbers
51	50	96	1	78	1	78	1451	15	51	03	1461	15	51
52	51	96	1	82	1	82	1489	80	52	03	1489	80	52
53	52	96	1	85	1	85	1518	45	53	03	1518	45	53
54	53	96	1	89	1	89	1547	10	54	03	1547	10	54
55	54	96	1	92	1	92	1575	75	55	03	1575	75	55
56	55	96	1	96	1	96	1604	40	56	04	1604	40	56
57	56	96	1	99	1	99	1633	05	57	04	1633	05	57
58	57	96	2	03	2	03	1661	70	58	04	1661	70	58
59	58	96	2	06	2	06	1690	35	59	04	1690	35	59
60	59	96	2	10	2	10	1719	00	60	04	1719	00	60
61	60	96	2	13	2	13	1747	65	61	04	1747	55	61
62	61	96	2	17	2	17	1776	30	62	04	1776	30	62
63	62	96	2	20	2	20	1804	95	63	04	1804	95	63
64	63	96	2	24	2	24	1833	60	64	04	1833	60	64
65	64	96	2	27	2	27	1862	25	65	04	1862	25	65
66	65	96	2	31	2	31	1890	90	66	04	1890	90	66
67	66	96	2	34	2	34	1919	55	67	04	1919	55	67
68	67	95	2	38	2	38	1948	20	68	04	1948	20	68
69	68	95	2	41	2	41	1976	85	69	04	1976	85	69
70	69	95	2	45	2	45	2005	50	70	04	2005	50	70
71	70	95	2	48	2	48	2034	15	71	04	2034	15	71
72	71	95	2	52	2	52	2062	80	72	04	2062	80	72
73	72	95	2	55	2	55	2091	45	73	04	2091	45	73
74	73	95	2	59	2	59	2120	10	74	04	2120	10	74
75	74	95	2	62	2	62	2148	75	75	04	2148	75	75
76	75	95	2	66	2	66	2177	40	76	04	2177	40	76
77	76	95	2	69	2	69	2206	05	77	04	2206	05	77
78	77	95	2	73	2	73	2234	70	78	04	2234	70	78
79	78	95	2	76	2	76	2263	35	79	04	2263	35	79
80	79	95	2	80	2	80	2292	00	80	05	2292	00	80
81	80	95	2	83	2	83	2320	65	81	05	2320	90	81
82	81	95	2	87	2	87	2345	30	82	05	2349	55	82
83	82	94	2	90	2	90	2377	95	83	05	2377	20	83
84	83	94	2	94	2	94	2406	60	84	05	2406	85	84
85	84	94	2	97	2	97	2435	25	85	05	2435	50	85
86	85	94	3	01	3	01	2463	90	86	05	2463	90	86
87	86	94	3	04	3	04	2492	55	87	05	2492	55	87
88	87	94	3	08	3	08	2521	20	88	05	2521	20	88
89	88	94	3	11	3	11	2549	85	89	05	2449	85	89
90	89	94	3	15	3	15	2578	50	90	05	2578	50	90
91	90	94	3	18	3	18	2607	15	91	05	2607	15	91
92	91	94	3	22	3	22	2635	80	92	05	2635	80	92
93	92	94	3	25	3	25	2664	45	93	05	2664	45	93
94	93	94	3	29	3	29	2693	10	94	05	2693	10	94
95	94	94	3	32	3	32	2721	75	95	05	2721	75	95
96	95	94	3	36	3	35	2750	40	96	06	2750	40	96
97	96	94	3	39	3	39	2779	05	97	06	2779	05	97
98	97	94	3	43	3	43	2807	70	98	06	2807	70	98
99	98	94	3	46	3	46	2836	35	99	06	2836	75	99
100	99	94	3	50	3	502	865	00	100	06	2865	00	100

7 Rumb and three quarters is 87 deg. 11 min.

Numbers	Sines Degrees 3 N.	pt.	87 N.	pt	Tangents Degrees 3 N.	pt	87 N.	pt.	Secants Degrees 3 N.	pt	87 N.	pts.	Numbers
1	00	99	0	5	0	5	19	10	1	00	19	10	1
2	01	99	0	10	0	10	38	20	2	00	38	20	2
3	02	99	0	16	0	16	57	30	3	00	57	30	3
4	03	99	0	21	0	21	76	40	4	01	76	40	4
5	04	99	0	26	0	26	95	50	5	01	95	50	5
6	05	99	0	31	0	31	114	60	6	01	114	60	6
7	06	99	0	37	0	37	133	70	7	01	133	70	7
8	07	99	0	42	0	42	152	80	8	01	152	80	8
9	08	99	0	47	0	47	171	90	9	01	171	90	9
10	09	99	0	52	0	52	191	00	10	01	191	00	10
11	10	98	0	58	0	58	210	10	11	02	210	10	11
12	11	98	0	63	0	63	229	20	12	02	229	20	12
13	12	98	0	68	0	68	248	30	13	02	248	30	13
14	13	98	0	73	0	73	267	40	14	02	267	40	14
15	14	98	0	79	0	79	286	50	15	02	286	50	15
16	15	98	0	84	0	84	305	60	16	02	305	60	16
17	16	98	0	89	0	89	324	70	17	02	324	70	17
18	17	97	0	94	0	94	343	80	18	03	343	80	18
19	18	97	1	00	1	00	362	90	19	03	362	90	19
20	19	97	1	05	1	05	382	00	20	03	382	00	20
21	20	97	1	10	1	10	401	10	21	03	401	10	21
22	21	97	1	15	1	15	420	20	22	03	420	20	22
23	22	97	1	20	1	20	439	30	23	03	439	30	23
24	23	96	1	26	1	26	458	40	24	03	458	40	24
25	24	96	1	31	1	31	477	50	25	04	477	50	25
26	25	96	1	36	1	36	496	60	26	04	496	10	26
27	26	96	1	41	1	41	515	70	27	04	515	20	27
28	27	96	1	47	1	47	534	80	28	04	534	30	28
29	28	96	1	52	1	52	553	90	29	04	553	40	29
30	29	96	1	57	1	57	573	00	30	04	573	50	30
31	30	96	1	62	1	62	592	10	31	04	592	60	31
32	31	95	1	68	1	68	611	20	32	05	611	70	32
33	32	95	1	73	1	73	630	30	33	05	630	80	33
34	33	95	1	78	1	78	649	40	34	05	649	90	34
35	34	95	1	83	1	83	668	50	35	05	668	00	35
36	35	95	1	89	1	89	687	60	36	05	687	10	36
37	36	95	1	94	1	94	706	70	37	05	706	20	37
38	37	95	2	00	2	00	725	80	38	05	725	30	38
39	38	95	2	06	2	06	744	90	39	06	744	40	39
40	39	94	2	09	2	09	764	00	40	06	764	50	40
41	40	94	2	15	2	15	783	10	41	06	783	10	41
42	41	94	2	20	2	20	802	20	42	06	802	20	42
43	42	94	2	25	2	25	821	30	43	06	821	30	43
44	43	94	2	30	2	30	840	40	44	06	840	40	44
45	44	94	2	36	2	36	859	50	45	06	859	50	45
46	45	93	2	41	2	41	878	60	46	07	878	60	46
47	46	93	2	46	2	46	897	70	47	07	897	70	47
48	47	93	2	51	2	51	916	80	48	07	916	80	48
49	48	93	2	57	2	57	935	90	49	07	935	90	49
50	49	93	2	62	2	62	955	00	50	07	955	00	50

o Rumb and a quarter is 2 deg. 49 min.

7 Rumb and three quarters is 87 deg. 11 min.

Numbers	Sines Degrees 3 N.pt.	Sines Degrees 87 N.pt.	Tangents Degrees 3 N.pt.	Tangents Degrees 87 N. pts.	Secants Degrees 3 N.pt	Secants Degrees 87 N. pts	Numbers
51	50 93	02 67	02 67	0974 10	51 07	0974 10	51
52	51 93	02 72	02 72	0993 0 20	52 07	0993 0 20	52
53	52 93	02 78	02 78	1012 0 30	53 07	1012 0 30	53
54	53 92	02 84	02 84	1031 0 40	54 08	1031 0 40	54
55	54 92	02 89	02 89	1050 50	55 08	1050 50	55
56	55 92	02 94	02 94	1069 60	56 08	1069 60	56
57	56 92	03 00	03 00	1088 70	57 08	1088 0 70	57
58	57 92	03 05	03 05	1107 80	58 08	1107 0 80	58
59	58 92	03 11	03 11	1126 90	59 08	1126 0 90	59
60	59 92	03 15	03 15	1146 00	60 08	1146 00	60
61	60 91	03 20	03 20	1165 10	61 09	1165 1 0	61
62	61 91	03 26	03 26	1184 20	62 09	1184 0 20	62
63	62 91	03 31	03 31	1203 30	63 09	1203 0 30	63
64	63 91	03 46	03 46	1222 40	64 09	1222 0 40	64
65	64 91	03 41	03 41	1241 50	65 09	1241 50	65
66	65 91	03 47	03 47	1260 60	66 09	1260 60	66
67	66 91	03 52	03 52	1279 70	67 09	1279 0 70	67
68	67 90	03 57	03 57	1298 80	68 09	1298 0 80	68
69	68 90	03 62	03 62	1317 90	69 10	1317 0 90	69
70	69 90	03 68	03 68	1337 00	70 10	1337 00	70
71	70 90	03 73	03 73	1356 10	71 10	1356 10	71
72	71 90	03 78	03 78	1375 20	72 10	1375 0 20	72
73	72 90	03 83	03 83	1394 30	73 10	1394 0 30	73
74	73 90	03 89	03 89	1413 40	74 10	1413 0 40	74
75	74 89	03 94	03 94	1432 50	75 11	1432 54	75
76	75 89	04 00	04 00	1451 60	76 11	1451 60	76
77	76 89	04 05	04 05	1470 70	77 11	1470 70	77
78	77 89	04 10	04 10	1489 80	78 11	1489 0 80	78
79	78 89	04 15	04 15	1508 90	79 11	1508 0 90	79
80	79 89	04 20	04 20	1528 00	80 11	1528 00	80
81	80 89	04 25	04 25	1547 10	81 11	1547 10	81
82	81 88	04 30	04 30	1566 20	82 12	1566 0 20	82
83	82 88	04 36	04 36	1585 30	83 12	1585 0 30	83
84	83 88	04 41	04 41	1604 40	84 12	1604 0 40	84
85	84 88	04 46	04 46	1623 50	85 12	1623 50	85
86	85 88	04 51	04 51	1642 60	86 12	1642 60	86
87	86 88	04 57	04 57	1661 70	87 12	1661 0 70	87
88	87 88	04 62	04 62	1680 80	88 12	1680 0 80	88
89	88 87	04 67	04 67	1699 90	89 13	1699 0 90	89
90	89 87	04 72	04 72	1719 00	90 13	1719 00	90
91	90 87	04 78	04 78	1738 10	91 13	1738 10	91
92	91 87	04 84	04 84	1757 20	92 13	1757 0 20	92
93	92 87	04 89	04 89	1776 30	93 13	1776 0 30	93
94	93 87	04 94	04 94	1795 40	94 13	1795 0 40	94
95	94 87	05 00	05 00	1814 50	95 13	1814 50	95
96	95 86	05 5	05 5	1833 60	96 14	1833 60	96
97	96 86	05 10	05 10	1852 70	97 14	1852 0 70	97
98	97 86	05 15	05 15	1871 80	98 14	1871 0 80	98
99	98 86	05 20	05 20	1890 90	99 14	1890 0 90	99
100	99 86	05 25	05 25	1910 0 00	100 14	1910 0 0100	

o Rumb and a quarter is 2 deg. 49 min.

Numbers	Sines Degrees 4 N. pt.	difference	86 N. pt	Tangents Degrees 4 N. pt	difference	86 N. pt.	Secants Degrees 4 N. pt	difference	86 N. ptss.	Numbers
1	00 99	0	07	0 07	0	14 30	1 00	0	14 34	1
2	01 99	0	14	0 14	0	28 60	2 00	0	28 68	2
3	02 99	0	21	0 21	0	43 90	3 01	0	43 02	3
4	03 99	0	28	0 24	0	57 20	4 01	0	57 36	4
5	04 99	0	35	0 35	0	71 50	5 01	0	71 70	5
6	05 98	0	42	0 42	0	85 80	6 01	0	85 04	6
7	06 98	0	49	0 49	0	100 10	7 02	0	100 38	7
8	07 98	0	56	0 56	0	114 40	8 02	0	114 72	8
9	08 98	0	63	0 63	0	128 70	9 02	0	129 06	9
10	09 97	0	70	0 70	0	143 00	10 02	0	143 40	10
11	10 97	0	77	0 77	0	157 30	11 03	0	157 74	11
12	11 97	0	84	0 84	0	171 60	12 03	0	172 08	12
13	12 97	0	91	0 91	0	185 90	13 03	0	186 42	13
14	13 96	0	98	0 98	0	200 20	14 03	0	200 76	14
15	14 96	1	05	1 05	0	214 50	15 04	0	215 10	15
16	15 96	1	12	1 12	0	228 80	16 04	0	229 44	16
17	16 96	1	19	1 19	0	243 10	17 04	0	243 78	17
18	17 95	1	26	1 26	0	257 40	18 04	0	258 12	18
19	18 95	1	33	1 33	0	271 70	19 05	0	272 46	19
20	19 95	1	40	1 40	0	286 00	20 05	0	286 80	20
21	20 95	1	47	1 47	0	300 30	21 05	0	301 14	21
22	21 95	1	54	1 54	0	314 60	22 05	0	315 48	22
23	22 94	1	61	1 61	0	328 90	23 06	0	328 82	23
24	23 94	1	68	1 68	0	347 20	24 06	0	344 16	24
25	24 94	1	75	1 75	0	357 50	25 06	0	358 50	25
26	25 94	1	82	1 82	0	371 80	26 06	0	372 08	26
27	26 93	1	89	1 89	0	386 10	27 07	0	387 18	27
28	27 93	1	96	1 96	0	400 40	28 07	0	401 52	28
29	28 93	2	03	2 03	0	414 70	29 07	0	415 86	29
30	29 93	2	10	2 10	0	429 00	30 07	0	430 20	30
31	30 92	2	17	2 17	0	443 30	31 08	0	444 54	31
32	31 92	2	24	2 24	0	457 60	32 08	0	458 88	32
33	32 92	2	31	2 31	0	471 90	33 08	0	473 22	33
34	33 92	2	38	2 38	0	486 20	34 08	0	487 56	34
35	34 91	2	45	2 45	0	500 50	35 08	0	501 90	35
36	35 91	2	52	2 52	0	514 80	36 09	0	516 24	36
37	36 91	2	59	2 59	0	529 10	37 09	0	530 58	37
38	37 91	2	66	2 66	0	543 40	38 09	0	544 92	38
39	38 90	2	73	2 73	0	557 70	39 10	0	556 26	39
40	39 90	2	80	2 80	0	572 00	40 10	0	573 60	40
41	40 90	2	87	2 87	0	586 30	41 10	0	587 94	41
42	41 90	2	94	2 94	0	600 60	42 10	0	602 28	42
43	42 89	3	01	3 01	0	614 90	43 11	0	616 62	43
44	43 89	3	08	3 08	0	629 20	44 11	0	630 96	44
45	44 89	3	15	3 15	0	643 50	45 11	0	645 30	45
46	45 89	3	22	3 22	0	657 80	46 11	0	659 64	46
47	46 88	3	29	3 29	0	672 10	47 12	0	673 98	47
48	47 88	3	36	3 36	0	686 40	48 12	0	688 32	48
49	48 88	3	43	3 43	0	700 70	49 12	0	702 66	49
50	49 88	3	50	3 50	0	715 00	50 12	7	17 00	50

Numbers	Sines Degrees 4 N.pt.	Sines Degrees 86 N.pt.	Tangents Degrees 4 N.pt.	Tangents Degrees 86 N. pts.	Secants Degrees 4 N.pt	Secants Degrees 86 N. pts	Numbers
51	50 87	03 57	03 57	729 30	51 12	731 34	51
52	51 87	03 64	03 64	743 60	52 12	745 68	52
53	52 87	03 71	03 71	757 90	53 13	760 02	53
54	53 87	03 78	03 78	772 20	54 13	774 36	54
55	54 86	03 85	03 85	786 50	55 13	788 70	55
56	55 86	03 92	03 92	800 80	56 13	803 04	56
57	56 86	03 99	03 99	815 10	57 14	817 38	57
58	57 86	04 06	04 06	829 40	58 14	831 72	58
59	58 85	04 13	04 13	843 70	59 14	846 06	59
60	59 85	04 20	04 20	858 00	60 14	860 40	60
61	60 85	04 27	04 27	872 30	61 15	874 74	61
62	61 85	04 34	04 34	886 60	62 15	889 08	62
63	62 84	04 41	04 41	900 90	63 15	903 42	63
64	63 84	04 48	04 48	915 20	64 15	917 76	64
65	64 84	04 55	04 55	929 50	65 16	932 10	65
66	65 84	04 62	04 62	943 80	66 16	946 44	66
67	66 83	04 69	04 69	958 10	67 16	960 78	67
68	67 83	04 76	04 76	972 40	68 16	975 12	68
69	68 83	04 83	04 83	986 70	69 17	989 46	69
70	69 83	04 90	04 90	1001 00	70 17	1003 80	70
71	70 82	04 97	04 97	1015 30	71 17	1018 14	71
72	71 82	05 04	05 04	1029 60	72 17	1032 48	72
73	72 82	05 11	05 11	1043 90	73 18	1046 82	73
74	73 82	05 18	05 18	1058 20	74 18	1061 16	74
75	74 82	05 25	05 25	1072 50	75 18	1075 50	75
76	75 81	05 32	05 32	1086 80	76 18	1089 84	76
77	76 81	05 39	05 39	1101 10	77 19	1104 18	77
78	77 81	05 46	05 46	1115 40	78 19	1118 52	78
79	78 81	05 53	05 53	1129 70	79 19	1132 86	79
80	79 80	05 60	05 60	1144 00	80 19	1147 16	80
81	80 80	05 67	05 67	1158 30	81 20	1161 54	81
82	81 80	05 74	05 74	1172 60	82 20	1175 88	82
83	82 80	05 81	05 81	1186 90	83 20	1190 22	83
84	83 79	05 88	05 88	1201 20	84 20	1204 56	84
85	84 79	05 95	05 95	1215 50	85 21	1218 90	85
86	85 79	06 02	06 02	1229 80	86 21	1233 24	86
87	86 79	06 09	06 09	1244 10	87 21	1247 58	87
88	87 78	06 16	06 16	1258 40	88 21	1261 92	88
89	88 78	06 23	06 23	1272 70	89 22	1276 26	89
90	89 78	06 30	06 30	1287 00	90 22	1290 60	90
91	90 78	06 37	06 37	1301 30	91 22	1304 94	91
92	91 77	06 44	06 44	1315 60	92 22	1319 28	92
93	92 77	06 51	06 51	1329 90	93 23	1333 62	93
94	93 77	06 58	06 58	1344 20	94 23	1347 96	94
95	94 77	06 65	06 65	1358 50	95 23	1362 30	95
96	95 76	06 72	06 72	1372 80	96 23	1376 64	96
97	96 76	06 79	06 79	1387 10	97 24	1390 98	97
98	97 76	06 86	06 86	1401 40	98 24	1405 32	98
99	98 76	06 93	06 93	1415 70	99 24	1419 66	99
100	99 76	07 00	07 00	1430 00	100 24	1434 00	100

Numbers	Sines Degrees 5 N. pt.	differences	85 N. pt	Tangents Degrees 5 N. pt	differences	85 N. pt	Secants Degrees 5 N. pt	differences	85 N. pts.	Numbers
1	00 99	0	00 09	00 09	0	11 43	01 01	0	11 48	1
2	01 99	0	00 17	00 17	0	22 86	02 01	0	22 96	2
3	01 99	0	00 26	00 26	0	34 29	03 01	0	34 44	3
4	03 98	0	00 35	00 35	0	45 72	04 02	0	45 92	4
5	04 98	0	00 44	00 44	0	57 15	05 02	0	57 40	5
6	05 98	0	00 52	00 52	0	68 58	06 02	0	68 88	6
7	06 97	1	00 61	00 61	0	80 01	07 03	0	80 36	7
8	07 97	0	00 70	00 70	0	91 44	08 03	0	91 84	8
9	08 97	0	00 79	00 79	0	102 87	09 03	0	103 32	9
10	09 96	1	00 87	00 87	0	114 30	10 04	0	114 82	10
11	10 96	0	00 96	00 96	0	125 73	11 04	0	126 28	11
12	11 96	0	01 05	01 05	0	137 16	12 04	0	137 76	12
13	12 95	1	01 14	01 14	0	148 59	13 05	0	149 24	13
14	13 95	0	01 22	01 22	0	160 02	14 05	0	160 72	14
15	14 95	0	01 31	01 31	0	171 45	15 05	0	172 20	15
16	15 94	1	01 40	01 40	0	182 88	16 06	0	183 68	16
17	16 94	0	01 49	01 49	0	194 31	17 06	0	195 16	17
18	17 93	1	01 57	01 57	0	205 74	18 06	0	206 64	18
19	18 93	0	01 66	01 66	0	217 17	19 07	0	218 12	19
20	19 92	1	01 75	01 75	0	228 60	20 08	0	229 60	20
21	20 92	0	01 84	01 84	0	240 03	21 08	0	241 08	21
22	21 91	1	01 92	01 92	0	251 46	22 08	0	252 56	22
23	22 91	0	02 01	02 01	0	262 89	23 09	0	264 04	23
24	23 91	0	02 10	02 10	0	274 32	24 09	0	275 52	24
25	24 91	0	02 19	02 19	0	285 75	25 09	0	287 00	25
26	25 90	1	02 27	02 27	0	297 18	26 10	0	298 48	26
27	26 90	0	02 36	02 36	0	308 61	27 10	0	309 96	27
28	27 90	0	02 45	02 45	0	320 04	28 10	0	321 44	28
29	28 89	1	02 54	02 54	0	331 47	29 11	0	332 92	29
30	29 89	0	02 62	02 62	0	342 90	30 11	0	344 40	30
31	30 89	0	02 71	02 71	0	354 33	31 11	0	355 88	31
32	31 88	1	02 80	02 80	0	365 76	32 12	0	367 36	32
33	32 88	0	02 89	02 89	0	377 19	33 12	0	378 84	33
34	33 88	0	02 97	02 97	0	388 62	34 12	0	390 32	34
35	34 87	1	03 06	03 06	0	400 05	35 13	0	401 80	35
36	35 87	0	03 15	03 15	0	411 48	36 13	0	413 28	36
37	36 86	1	03 24	03 24	0	422 91	37 14	0	424 76	37
38	37 86	0	03 32	03 32	0	434 34	38 14	0	436 24	38
39	38 86	0	03 41	03 41	0	445 77	39 14	0	447 72	39
40	39 85	1	03 50	03 50	0	457 20	40 15	0	459 20	40
41	40 85	0	03 59	03 59	0	468 63	41 15	0	470 68	41
42	41 85	0	03 67	03 67	0	480 06	42 15	0	482 16	42
43	42 84	1	03 76	03 76	0	491 49	43 16	0	493 64	43
44	43 84	0	03 85	03 85	0	502 92	44 16	0	505 12	44
45	44 84	0	03 94	03 94	0	514 35	45 16	0	516 60	45
46	45 83	1	04 02	04 02	0	525 78	46 17	0	528 08	46
47	46 83	0	04 11	04 11	0	537 21	47 17	0	539 56	47
48	47 82	1	04 20	04 20	0	548 64	48 18	0	551 04	48
49	48 82	0	04 29	04 29	0	560 07	49 18	0	562 52	49
50	49 81	1	04 37	04 37	0	571 50	50 19	0	574 00	50

Numbers	Sines Degrees 5 N.pts.	85 N.pt.	Tangents Degrees 5 N.pt.	85 N. pts.	Secants Degrees 5 N.pt	85 N. pts.	Numbers
51	50 81	04 45	04 45	582 93	51 19	585 48	51
52	51 81	04 54	04 54	594 36	52 19	596 96	52
53	52 80	04 62	04 62	605 79	53 20	608 44	53
54	53 80	04 71	04 71	617 22	54 20	619 92	54
55	54 79	04 80	04 80	628 65	55 21	631 40	55
56	55 79	04 89	04 89	640 08	55 21	642 88	56
57	56 79	04 98	04 98	651 51	57 22	654 36	57
58	57 78	05 07	05 07	662 94	57 22	665 84	58
59	58 78	05 16	05 16	674 37	59 22	677 32	59
60	59 77	05 25	05 25	685 80	60 23	688 80	60
61	60 77	05 34	05 34	697 23	61 23	700 28	61
62	61 76	05 42	05 42	708 66	62 24	711 76	62
63	62 76	05 51	05 51	720 09	63 24	723 24	63
64	63 76	05 60	05 60	731 52	64 24	734 72	64
65	64 75	05 69	05 69	742 95	65 25	746 20	65
66	65 75	05 77	05 77	754 38	66 27	757 68	66
67	66 74	05 86	05 86	765 81	67 27	769 16	67
68	67 74	05 95	05 95	777 24	68 28	780 64	68
69	68 74	06 04	06 04	788 67	69 28	792 16	69
70	69 73	06 12	06 12	800 10	70 28	803 60	70
71	70 73	06 21	06 21	811 53	71 27	815 08	71
72	71 73	06 30	06 30	822 96	72 27	826 56	72
73	72 72	06 39	06 39	834 39	73 28	838 04	73
74	73 72	06 47	06 47	845 82	74 28	849 52	74
75	74 72	06 56	06 56	857 25	75 28	861 00	75
76	75 71	06 65	06 65	868 68	76 29	872 48	76
77	76 71	06 74	06 74	880 11	77 29	883 96	77
78	77 71	06 82	06 82	891 54	78 29	895 44	78
79	78 70	06 91	06 91	902 97	79 30	906 92	79
80	79 70	07 00	07 00	914 40	80 30	918 40	80
81	80 70	07 09	07 09	925 83	81 30	929 88	81
82	81 69	07 17	07 17	937 26	82 31	941 36	82
83	82 69	07 26	07 26	948 69	83 31	952 84	83
84	83 68	07 35	07 35	960 12	84 32	964 32	84
85	84 68	07 44	07 44	971 55	85 32	975 80	85
86	85 68	07 52	07 52	982 98	86 32	987 28	86
87	86 67	07 61	07 61	994 41	87 33	998 76	87
88	87 67	07 70	07 70	1005 84	88 33	1010 24	88
89	88 67	07 79	07 79	1017 27	89 33	1021 72	89
90	89 66	07 87	07 87	1028 70	90 34	1033 20	90
91	90 66	07 96	07 96	1040 13	91 34	1045 68	91
92	91 65	08 05	08 05	1051 56	92 35	1057 16	92
93	92 65	08 14	08 14	1062 99	93 35	1068 64	93
94	93 65	08 22	08 22	1074 42	94 35	1080 12	94
95	94 64	08 31	08 31	1085 85	95 36	1091 60	95
96	95 64	08 40	08 40	1097 28	96 36	1113 08	96
97	96 63	08 49	08 49	1108 71	97 37	1114 56	97
98	97 63	08 57	08 57	1120 14	98 37	1126 04	98
99	98 62	08 66	08 66	1131 57	99 38	1137 52	99
100	99 62	08 75	08 75	1143 00	100 38	1149 00	100

Numbers	Sines Degrees 6 N.pt		Sines Degrees 84 N.pt		Tangents Degrees 6 N.pt.		Tangents Degrees 84 N.pts.		Secants Degrees 6 N. pt		Secants Degrees 84 N. pts.	
1	00	99	00	10	00	11	99	51	01	01	9	57
2	01	99	00	21	00	21	19	03	02	01	18	13
3	02	98	00	31	00	32	28	54	03	02	28	70
4	03	98	00	42	00	42	38	06	04	03	38	27
5	04	97	00	52	00	53	47	57	05	03	47	83
6	05	97	00	63	00	63	57	09	06	03	57	40
7	06	96	00	73	00	74	66	60	07	04	66	97
8	07	96	00	84	00	84	76	12	08	04	76	53
9	08	95	00	94	00	95	85	63	09	05	86	10
10	09	95	01	05	01	05	95	15	10	06	95	67
11	10	94	01	15	01	16	104	66	11	06	105	23
12	11	93	01	25	01	26	114	18	12	07	114	80
13	12	93	01	36	01	37	123	69	13	07	124	37
14	13	92	01	46	01	47	133	21	14	07	133	93
15	14	92	01	57	01	58	142	72	15	08	143	50
16	15	91	01	67	01	68	152	24	16	09	153	07
17	16	91	01	78	01	79	161	75	17	09	162	63
18	17	90	01	88	01	89	171	27	18	10	172	20
19	18	90	01	99	02	00	180	78	19	10	181	77
20	19	89	02	09	02	10	190	30	20	11	191	33
21	20	89	02	19	02	21	199	81	21	11	200	90
22	21	88	02	30	02	31	208	33	22	12	210	47
23	22	88	02	40	02	42	218	84	23	12	220	03
24	23	87	02	51	02	52	228	36	24	13	229	60
25	24	87	02	61	02	63	237	87	25	13	239	17
26	25	86	02	72	02	73	247	39	26	14	248	73
27	26	86	02	82	02	84	256	90	27	14	258	30
28	27	85	02	93	02	94	266	42	28	15	267	87
29	28	85	03	03	03	05	275	93	29	15	277	49
30	29	84	03	14	03	15	285	45	30	16	287	00
31	30	83	03	24	03	26	294	66	31	17	296	57
32	31	83	03	34	03	36	304	48	32	17	306	13
33	32	82	03	45	03	47	313	99	33	18	315	70
34	33	82	03	55	03	57	323	51	34	18	325	27
35	34	81	03	66	03	68	333	02	35	19	334	83
36	35	84	03	76	03	78	342	54	36	19	344	40
37	36	80	03	87	03	89	352	05	37	20	353	97
38	37	80	03	97	03	99	361	57	38	20	363	53
39	38	79	04	08	04	10	371	08	39	21	373	10
40	39	78	04	18	04	20	380	60	40	22	382	67
41	40	77	04	28	04	31	390	01	41	23	392	23
42	41	77	04	39	04	41	399	63	42	23	401	80
43	42	76	04	49	04	52	409	14	43	24	411	37
44	43	75	04	60	04	62	418	66	44	25	421	73
45	44	74	04	70	04	73	428	17	45	26	431	30
46	45	74	04	81	04	83	437	69	46	26	440	87
47	46	73	04	91	04	94	447	20	47	27	449	63
48	47	73	05	02	05	04	456	72	48	28	459	20
49	48	72	05	12	05	15	466	23	49	28	468	77
50	49	72	05	22	05	25	475	75	50	28	478	34

Numbers	Sines Degrees 6 N. pts.	Sines Degrees 84 N. pts.	Tangents Degrees 6 N. pts	Tangents Degrees 84 N. pts.	Secants Degrees 6 N. pts.	Secants Degrees 84 N. pts	Numbers
51	50 72	05 33	05 36	485 26	51 20	487 91	51
52	51 72	05 43	05 46	494 78	52 29	497 48	52
53	52 71	05 54	05 57	504 29	53 29	507 04	53
54	53 70	05 64	05 67	513 81	54 30	516 61	54
55	54 70	05 77	05 78	523 32	55 30	526 18	55
56	55 69	05 85	05 88	532 84	56 31	535 74	56
57	56 69	05 96	05 99	542 35	57 31	545 31	57
58	57 68	06 06	06 09	551 87	58 32	554 88	58
59	58 68	06 17	06 20	561 38	59 32	564 45	59
60	59 67	06 27	06 31	570 90	60 33	574 01	60
61	60 66	06 37	06 41	580 41	61 34	583 58	61
62	61 65	06 48	06 52	589 93	62 35	593 14	62
63	62 65	06 58	06 62	599 44	63 35	602 71	63
64	63 64	06 69	06 73	608 96	64 36	612 28	64
65	64 64	06 79	06 83	618 47	65 36	621 84	65
66	65 63	06 90	06 94	627 99	66 37	631 41	66
67	66 63	07 00	07 04	637 50	67 37	640 98	67
68	67 62	07 11	07 15	647 02	68 38	650 55	68
69	68 62	07 21	07 25	656 53	69 38	660 11	69
70	69 61	07 32	07 36	666 05	70 39	669 68	70
71	70 61	07 42	07 46	675 56	71 39	679 24	71
72	71 60	07 53	07 57	685 08	72 40	688 81	72
73	72 60	07 63	07 67	694 59	73 40	698 38	73
74	73 59	07 74	07 78	704 11	74 41	707 94	74
75	74 59	07 84	07 83	713 62	75 41	717 51	75
76	75 58	07 95	07 99	723 14	76 42	727 08	76
77	76 58	08 05	08 09	732 65	77 42	736 65	77
78	77 57	08 15	08 20	742 17	78 43	746 21	78
79	78 57	08 26	08 31	751 68	79 43	755 78	79
80	79 56	08 36	08 41	761 20	80 44	765 34	80
81	80 55	08 47	08 51	770 71	81 45	774 91	81
82	81 54	08 57	08 62	780 23	82 46	784 48	82
83	82 54	08 68	08 72	789 74	83 46	794 04	83
84	83 53	08 78	08 83	799 26	84 47	803 61	84
85	84 53	08 89	08 93	808 77	85 47	813 18	85
86	85 52	08 99	09 04	818 29	86 48	822 75	86
87	86 52	09 10	09 14	827 80	87 48	832 31	87
88	87 51	09 20	09 25	837 32	88 49	841 88	88
89	88 51	09 31	09 35	846 83	89 49	851 44	89
90	89 50	09 41	09 46	856 35	90 50	861 01	90
91	90 50	09 51	09 56	865 86	91 51	870 58	91
92	91 49	09 62	09 67	875 38	92 51	880 14	92
93	92 49	09 72	09 77	884 89	93 51	889 71	93
94	93 48	09 83	09 88	894 41	94 52	899 28	94
95	94 48	09 93	01 98	903 92	95 52	908 85	95
96	95 47	10 04	10 09	913 44	96 53	918 4	96
97	96 47	10 14	10 19	922 95	97 053	927 098	97
98	97 46	10 25	10 30	932 47	98 053	937 854	98
99	98 46	10 35	10 40	941 98	99 054	947 611	99
100	99 45	10 45	10 51	951 50	100 55	956 68	100

Numbers	Sines Degrees 7 N.pt	Sines Degrees 83 N.pt	Tangents Degrees 7 N.pt.	Tangents Degrees 83 N.pts.	Secants Degrees 7 N. pt	Secants Degrees 83 N. pts.	Numbers
1	00 99	00 12	00 12	8 14	01 01	8 21	1
2	01 99	00 24	00 25	16 29	02 01	16 41	2
3	02 98	00 37	00 37	24 43	03 02	24 62	3
4	03 97	00 49	00 49	32 58	04 03	32 82	4
5	04 96	00 61	00 61	40 72	05 04	41 03	5
6	05 96	00 73	00 74	48 87	06 04	49 23	6
7	06 95	00 85	00 86	57 01	07 05	57 44	7
8	07 94	00 98	00 98	65 15	08 06	65 64	8
9	08 93	01 10	01 11	73 30	09 07	73 85	9
10	09 92	01 22	01 23	81 44	10 08	82 06	10
11	10 92	01 34	01 35	89 59	11 08	90 26	11
12	11 91	01 47	01 47	97 73	12 09	98 47	12
13	12 90	01 59	01 60	105 88	13 10	106 67	13
14	13 89	01 71	01 72	114 02	14 11	114 88	14
15	14 89	01 83	01 84	122 16	15 11	123 08	15
16	15 88	01 95	01 96	130 31	16 12	131 29	16
17	16 87	02 08	02 09	138 45	17 13	139 49	17
18	17 86	02 20	02 21	146 60	18 14	147 70	18
19	18 86	02 32	02 33	154 74	19 14	155 90	19
20	19 85	02 44	02 46	162 89	20 15	164 11	20
21	20 84	02 57	02 58	171 03	21 16	172 31	21
22	21 83	02 69	02 70	179 17	22 17	180 52	22
23	22 83	02 81	02 82	187 32	23 17	188 72	23
24	23 82	02 93	02 95	195 46	24 18	196 93	24
25	24 81	03 05	03 07	203 61	25 19	205 13	25
26	25 80	03 18	03 19	211 75	26 20	213 34	26
27	26 80	03 30	03 31	219 90	27 20	221 54	27
28	27 79	03 42	03 44	228 04	28 21	229 75	28
29	28 78	03 54	03 56	236 18	29 22	237 95	29
30	29 78	03 67	03 68	244 33	30 22	246 16	30
31	30 77	03 79	03 81	252 47	31 23	254 37	31
32	31 76	03 91	03 93	260 62	32 24	262 57	32
33	32 75	04 03	04 05	268 76	33 25	270 78	33
34	33 74	04 15	04 17	276 91	34 26	278 98	34
35	34 74	04 28	04 30	285 05	35 26	287 19	35
36	35 73	04 40	04 42	293 19	36 27	295 39	36
37	36 72	04 52	04 54	301 34	37 28	303 60	37
38	37 72	04 64	04 67	309 48	38 28	311 80	38
39	38 71	04 77	04 79	317 63	39 29	320 01	39
40	39 70	04 89	04 91	325 77	40 30	328 22	40
41	40 69	05 01	05 03	333 92	41 31	336 42	41
42	41 69	05 13	05 16	342 06	42 31	344 62	42
43	42 68	05 25	05 28	350 20	43 32	352 83	43
44	43 67	05 38	05 40	358 35	44 33	361 03	44
45	44 66	05 50	05 53	366 49	45 34	369 24	45
46	45 66	05 62	05 65	374 64	46 34	377 45	46
47	46 65	05 74	05 77	382 78	47 35	385 65	47
48	47 64	05 86	05 89	390 93	48 36	393 86	48
49	48 63	05 98	06 02	399 07	49 37	402 07	49
50	49 63	06 11	06 14	407 22	50 37	410 28	50

Numbers	Sines Degrees 7 N.pt.	Sines Degrees 83 N.pt.	Tangents Degrees 7 N.pt.	Tangents Degrees 83 N.pts.	Secants Degrees 7 N. pt.	Secants Degrees 83 N.pts.	Numbers
51	50 62	06 22	06 27	415 36	51 38	418 48	51
52	51 61	06 34	06 39	423 50	52 39	425 69	52
53	52 60	06 47	06 51	431 65	53 40	434 19	53
54	53 60	06 59	7 64 64	439 79	54 42	443 10	54
55	54 59	07 71	06 76	447 94	55 41	451 30	55
56	55 58	06 73	06 88	456 08	56 42	459 51	56
57	56 57	06 95	07 1 01	464 30 22	57 43	467 71	57
58	57 56	07 08	07 1 13	472 79 37	58 44	475 92	58
59	58 56	07 120	07 2 25	480 51	59 44	484 12	59
60	59 55	07 32	07 37	488 66	60 45	492 33	60
61	60 54	07 44	07 50	496 80	61 46	500 53	61
62	61 53	07 57	07 1 62	504 95	62 47	508 66 74	62
63	62 53	07 69	07 1 74	513 09	63 47	516 94	63
64	63 52	07 81	07 2 86	521 86 23	64 48	525 81 15	64
65	64 51	07 93	07 99	529 38	65 49	533 35	65
66	65 51	08 05	08 11	537 52	66 49	541 56	66
67	66 50	08 18	08 1 23	545 67	67 50	549 76	67
68	67 49	08 30	08 1 36	553 81	68 51	557 97	68
69	68 48	08 42	08 1 48	561 96	69 52	566 17	69
70	69 47	08 54	08 60	570 10	70 53	574 38	70
71	70 47	08 67	08 72	578 24	71 53	582 59	71
72	71 46	08 79	08 1 85	586 39	72 54	590 79	72
73	72 45	08 91	08 1 97	594 53	73 55	599 00	73
74	73 45	09 03	09 09	602 68	74 55	607 20	74
75	74 44	09 15	09 21	610 82	75 56	615 41	75
76	75 43	09 28	09 34	618 97	76 57	623 61	76
77	76 43	09 40	09 1 46	627 11	77 58	631 82	77
78	77 42	09 52	09 1 58	635 25	78 58	640 02	78
79	78 41	09 64	09 1 71	643 40	79 59	648 23	79
80	79 40	09 76	09 83	651 54	80 60	656 44	80
81	80 39	09 88	09 95	659 69	81 61	664 64	81
82	81 39	09 90	10 07	667 83	82 61	672 85	82
83	82 38	10 02	10 1 20	675 97	83 62	681 05	83
84	83 37	10 14	10 1 32	684 12	84 63	689 26	84
85	84 36	10 27	10 44	692 26	85 64	697 46	85
86	85 36	10 39	10 57	700 41	86 64	705 67	86
87	86 35	10 51	10 69	708 55	87 65	713 87	87
88	87 34	10 63	10 1 81	716 70	88 66	722 08	88
89	88 33	10 86	10 1 93	724 84	89 67	730 28	89
90	89 32	10 98	11 06	732 98	90 68	738 49	90
91	90 32	11 10	11 18	741 13	91 68	746 69	91
92	91 31	11 23	11 1 30	749 27	92 69	754 90	92
93	92 30	11 35	11 1 43	757 42	93 70	763 10	93
94	93 29	11 47	11 1 55	765 56	94 71	771 31	94
95	94 29	11 59	11 67	773 71	95 71	779 52	95
96	95 28	11 71	11 79	781 85	96 72	787 72	96
97	96 27	11 83	11 1 92	789 99	97 73	795 93	97
98	97 26	11 96	12 1 04	798 14	98 74	804 13	98
99	98 26	12 08	12 1 16	806 28	99 74	812 34	99
100	99 25	12 20	12 28	814 42	100 75	820 55	100

7 Rumb and a quarter is 81 deg. 34 min.

Numbers	Sines Degrees 8 N.	pt.	Sines Degrees 82 N.	pt	Tangents Degrees 8 N.	pt	Tangents Degrees 82 N.	pt.	Secants Degrees 8 N.	pt	Secants Degrees 82 N	pts.	Numbers
1	00	99	00	14	00	14	7	12	01	01	7	18	1
2	01	98	00	28	00	28	14	23	02	02	14	37	2
3	02	97	00	42	00	42	21	35	03	03	21	56	3
4	03	96	00	56	00	56	28	46	04	04	28	74	4
5	04	95	00	70	00	70	35	58	04	05	35	92	5
6	05	94	00	84	00	84	42	69	06	06	43	11	6
7	06	93	00	97	00	98	49	81	07	07	50	30	7
8	07	92	01	11	01	12	56	92	08	08	57	48	8
9	08	91	01	25	01	26	64	04	09	09	64	67	9
10	09	90	01	39	01	40	71	15	10	10	71	85	10
11	10	89	01	53	01	54	78	26	11	11	79	0[illegible]	11
12	11	88	01	67	01	68	85	38	12	12	86	2[illegible]	12
13	12	87	01	81	01	82	92	50	13	13	93	42	13
14	13	86	01	95	01	96	99	61	14	14	100	59	14
15	14	85	02	09	02	10	106	73	15	15	107	78	15
16	15	84	02	23	02	24	113	84	16	16	114	96	16
17	16	83	02	36	02	38	120	96	17	17	122	15	17
18	17	82	02	50	02	52	128	07	18	18	129	33	18
19	18	81	02	64	02	66	135	19	19	19	136	52	19
20	19	80	02	78	02	81	142	30	20	20	143	70	20
21	20	80	02	92	02	95	149	42	21	21	150	88	21
22	21	79	03	06	03	09	156	53	22	22	158	07	22
23	22	78	03	20	03	24	163	65	23	23	165	26	23
24	23	77	03	34	03	38	170	76	24	24	172	44	24
25	24	76	03	48	03	52	177	88	25	25	179	62	25
26	25	75	03	62	03	66	184	99	26	26	186	81	26
27	26	74	03	75	03	79	192	11	27	27	194	00	27
28	27	73	03	89	03	83	199	22	28	28	201	18	28
29	28	72	04	03	04	07	206	34	29	29	208	37	29
30	29	71	04	17	04	22	213	46	30	29	215	56	30
31	30	70	04	31	04	36	220	57	31	30	222	27	31
32	31	69	04	45	04	50	227	69	32	31	229	93	32
33	32	68	04	59	04	64	234	81	33	32	237	15	33
34	33	67	04	73	04	78	241	92	34	33	244	30	34
35	34	66	04	87	04	92	249	04	35	34	251	49	35
36	35	65	05	01	05	06	256	15	36	35	258	67	36
37	36	64	05	15	05	20	263	27	37	36	265	86	37
38	37	63	05	29	05	34	270	38	38	37	273	04	38
39	38	62	05	43	05	48	277	58	39	38	280	23	39
40	39	61	05	57	05	62	284	61	40	39	287	41	40
41	40	60	05	71	05	77	291	73	41	40	294	59	41
42	41	59	05	85	05	91	298	84	42	41	301	78	42
43	42	58	05	98	06	04	305	96	43	42	308	97	43
44	43	57	06	12	06	18	313	07	44	43	316	15	44
45	44	56	06	26	06	32	320	29	45	44	323	33	45
46	45	55	06	40	06	46	327	30	46	45	330	52	46
47	46	54	06	54	06	60	334	42	47	46	337	71	47
48	47	53	06	68	06	74	341	53	48	47	344	89	48
49	48	52	06	82	06	88	348	65	49	48	352	08	49
50	49	51	06	96	07	03	355	77	50	49	359	27	50

Sines: difference 0.02, 0.14, 0.03, 0.22, 0.04, 0.31, 0.05, 0.39, 0.07, 0.48, 0.08, 0.57, 0.09, 0.65, 0.10, 0.74, 0.11, 0.83

Tangents: difference 0.14, 0.20, 0.23, 13.40, 0.32, 18.50, 0.41, 23.70, 0.50, 28.80, 0.59, 34.00, 0.68, 39.10, 0.77, 44.30, 0.86, 49.40

Secants: difference 0.02, 0.03, 0.05, 0.06, 0.07, 0.09, 0.10, 0.11, 0.12, 13.26, 18.36, 23.40, 28.56, 33.66, 38.76, 43.86, 48.96

0 Rumb three quarters is 8 deg. 26 min.

7 Rumb and a quarter, is 81 deg. 34 min.

Numbers	Sines Degrees 8 N.pt.	Sines Degrees 82 N.pt.	Tangents Degrees 8 N.pts.	Tangents Degrees 82 N.pts.	Secants Degrees 8 N.pt.	Secants Degrees 82 N.pts.	Numbers
51	50 51	7 10	7 17	362 88	51 50	366 45	51
52	51 50	7 02 4	7 31	370 51	52 51	373 64	52
53	52 49	7 01 37	7 45	377 12	53 52	380 82	53
54	53 48	7 01 51	7 59	384 23	54 53	387 99	54
55	54 47	7 01 65	7 73	391 35	55 54	395 19	55
56	55 46	7 01 79	7 87	498 46	56 55	402 38	56
57	56 45	7 01 93	8 01	405 58	57 56	409 57	57
58	57 44	8 00 07	8 15	412 69	58 57	416 75	58
59	58 43	8 00 21	8 29	419 81	59 58	423 94	59
60	59 42	8 00 35	8 43	426 92	60 59	431 12	60
61	60 41	8 00 49	8 57	434 04	61 60	438 30	61
62	61 40	8 00 63	8 75	441 15	62 61	445 49	62
63	62 39	8 00 76	8 85	448 27	63 62	452 68	63
64	63 38	8 00 90	8 99	455 38	64 63	459 86	64
65	64 37	8 01 04	9 14	462 50	65 64	467 04	65
66	65 36	9 01 18	9 28	469 61	66 65	474 23	66
67	66 35	9 01 32	9 42	476 73	67 66	481 42	67
68	67 34	9 01 46	9 56	483 84	68 67	488 60	68
69	68 33	9 01 60	9 70	490 96	69 68	495 79	69
70	69 32	9 01 74	9 84	498 08	70 69	502 97	70
71	70 31	9 01 88	9 98	505 19	71 70	510 15	71
72	71 30	10 02 02	10 12	512 31	72 71	517 34	72
73	72 29	10 02 16	10 26	519 43	73 72	524 52	73
74	73 28	10 02 30	10 40	526 54	74 73	531 70	74
75	74 27	10 02 44	10 54	533 66	75 74	538 89	75
76	75 26	10 02 58	10 68	540 77	76 75	546 08	76
77	76 25	10 03 72	10 82	547 89	77 76	553 27	77
78	77 24	10 03 86	10 96	555 00	78 77	560 45	78
79	78 23	10 03 99	11 10	562 12	79 78	567 64	79
80	79 22	11 03 13	11 24	569 23	80 79	574 82	80
81	80 21	11 03 27	11 38	576 35	81 80	582 00	81
82	81 20	11 03 41	11 52	583 46	82 81	589 19	82
83	82 19	11 03 55	11 66	590 58	83 82	596 38	83
84	83 18	11 03 69	11 80	597 70	84 83	603 56	84
85	84 17	11 03 83	11 95	604 81	85 84	610 74	85
86	85 16	11 03 97	12 09	611 92	86 85	617 93	86
87	86 15	12 04 11	12 23	619 04	87 86	625 12	87
88	87 14	12 04 25	12 37	626 15	88 87	632 30	88
89	88 13	12 04 38	12 51	633 27	89 88	639 49	89
90	89 12	12 04 53	12 65	640 38	90 88	646 68	90
91	90 11	12 04 66	12 79	647 50	91 89	653 86	91
92	91 10	12 04 80	12 93	654 62	92 90	661 05	92
93	92 09	12 04 94	13 07	661 73	93 91	668 23	93
94	93 08	13 05 08	13 21	668 85	94 92	675 41	94
95	94 07	13 05 22	13 35	675 97	95 93	682 60	95
96	95 06	13 05 36	13 49	683 08	96 94	689 79	96
97	96 05	13 05 50	13 63	690 20	97 95	696 98	97
98	97 04	13 05 64	13 77	697 31	98 96	704 16	98
99	98 03	13 05 77	13 91	704 43	99 97	711 35	99
100	99 03	13 05 92	14 05	711 54	100 98	718 53	100

o Rumb three quarters, is 8 deg. 26 min.

Numbers	Sines Degrees 9 N.pt	differences	81 N.pt.	Tangents Degrees 9 N.pt.	differences	81 N.pts.	Secants Degrees 9 N. pt	differences	81 N.pts.	Numbers
1	0 99	1	0 16	0 16	16	6 31	01 02	1	6 39	1
2	1 98	2	0 31	0 32	16	12 63	02 03	1	12 78	2
3	2 96	1	0 47	0 48	16	18 94	03 04	1	19 18	3
4	3 95	2	0 63	0 64	15	25 26	04 05	1	25 57	4
5	4 94	1	0 78	0 79	16	31 57	05 06	1	31 96	5
6	5 93	2	0 94	0 95	16	37 88	06 07	1	38 35	6
7	6 91	1	1 10	1 11	16	44 20	07 09	2	44 75	7
8	7 90	2	1 25	1 27	16	50 51	08 10	1	51 14	8
9	8 89	1	1 41	1 43	16	56 82	09 11	1	57 53	9
10	9 88	1	1 56	1 58	16	63 14	10 12	1	63 92	10
11	10 86	2	1 72	1 74	16	69 45	11 14	2	70 31	11
12	11 85	1	1 88	1 89	16	75 77	12 15	1	76 70	12
13	12 84	1	2 03	2 05	16	82 08	13 16	1	83 10	13
14	13 83	2	2 19	2 21	16	88 39	14 17	1	89 49	14
15	14 81	2	2 35	2 37	16	94 71	15 19	2	95 88	15
16	15 80	2	2 50	2 53	16	101 02	16 20	1	102 27	16
17	16 79	2	2 66	2 69	16	107 33	17 21	1	108 67	17
18	17 78	2	2 82	2 85	16	113 65	18 22	1	115 06	18
19	18 76	2	2 97	3 01	16	119 96	19 24	2	121 45	19
20	19 75	3	3 13	3 17	16	126 28	20 25	1	127 85	20
21	20 74	3	3 29	3 33	16	132 59	21 26	1	134 24	21
22	21 73	3	3 45	3 49	16	138 90	22 27	1	140 63	22
23	22 71	3	3 62	3 65	16	145 22	23 28	1	147 02	23
24	23 70	3	3 76	3 81	16	151 53	24 30	2	153 41	24
25	24 69	3	3 92	3 97	16	157 85	25 31	1	159 80	25
26	25 68	4	4 07	4 12	16	164 16	26 32	1	166 20	26
27	26 66	4	4 23	4 28	16	170 47	27 34	2	172 59	27
28	27 65	4	4 39	4 44	16	176 79	28 35	1	178 98	28
29	28 64	4	4 55	4 60	16	183 10	29 36	1	185 37	29
30	29 63	4	4 69	4 75	15	189 42	30 37	1	191 77	30
31	30 61	4	4 86	4 91	16	195 72	31 39	2	198 16	31
32	31 60	5	5 02	5 07	16	202 04	32 40	1	204 55	32
33	32 59	5	5 17	5 23	16	208 35	33 41	1	210 95	33
34	33 58	5	5 33	5 39	16	214 67	34 42	1	217 34	34
35	34 56	5	5 49	5 54	15	220 98	35 44	2	223 73	35
36	35 55	5	5 65	5 70	16	227 29	36 45	1	230 12	36
37	36 54	5	5 80	5 86	16	233 61	37 46	1	236 51	37
38	37 53	5	5 96	6 02	16	239 92	38 47	1	242 90	38
39	38 52	6	6 12	6 18	16	246 23	39 48	1	249 30	39
40	39 51	6	6 26	6 34	16	252 55	40 50	2	255 69	40
41	40 50	6	6 41	6 50	16	258 86	41 51	1	262 08	41
42	41 49	6	6 57	6 66	16	265 18	42 52	1	268 47	42
43	42 48	6	6 73	6 82	16	271 49	43 54	2	274 87	43
44	43 46	6	6 88	6 98	16	277 80	44 55	1	281 26	44
45	44 45	7	7 04	7 13	15	284 11	45 56	1	287 65	45
46	45 44	7	7 20	7 29	16	290 43	46 57	1	294 05	46
47	46 43	7	7 35	7 45	16	296 75	47 59	2	300 44	47
48	47 41	7	7 51	7 61	16	303 06	48 60	1	306 83	48
49	48 40	7	7 66	7 77	16	309 38	49 61	1	313 22	49
50	49 38	7	7 82	7 92	15	315 69	50 62	1	319 61	50

Numbers	Sines Degrees 9 N.pt.	Sines Degrees 81 N.pt.	Tangents Degrees 9 N.pt.	Tangents Degrees 81 N.pts.	Secants Degrees 9 N.pt.	Secants Degrees 81 N.pts.	Numbers
51	50 38	7 98	8 08	322 00	51 64	326 00	51
52	51 36	8 14	8 24	328 31	52 65	332 40	52
53	52 35	8 30	8 40	334 63	53 66	338 79	53
54	53 34	8 45	8 56	340 94	54 67	345 18	54
55	54 33	8 61	8 71	347 26	55 69	351 57	55
56	55 31	8 76	8 87	353 57	56 70	357 97	56
57	56 30	8 92	9 03	359 88	57 71	364 36	57
58	57 29	9 08	9 19	366 20	58 72	370 75	58
59	58 28	9 23	9 35	372 51	59 74	377 15	59
60	59 27	9 39	9 50	378 82	60 75	383 54	60
61	60 25	9 55	9 66	385 14	61 76	389 93	61
62	61 24	9 70	9 82	391 45	62 77	396 32	62
63	62 23	9 86	9 98	397 77	63 79	402 71	63
64	63 21	10 02	10 14	404 08	64 80	409 10	64
65	64 20	10 17	10 29	410 39	65 81	415 50	65
66	65 19	10 33	10 45	416 71	66 82	421 89	66
67	66 18	10 49	10 61	423 02	67 84	428 28	67
68	67 16	10 65	10 77	429 33	68 85	434 67	68
69	68 15	10 80	10 93	435 65	69 86	441 07	69
70	69 14	10 95	11 09	441 96	70 87	447 47	70
71	70 13	11 11	11 25	448 28	71 88	453 86	71
72	71 11	11 26	11 41	454 59	72 90	460 26	72
73	72 10	11 42	11 57	460 90	73 91	466 65	73
74	73 09	11 58	11 73	467 21	74 92	473 04	74
75	74 08	11 73	11 88	473 53	75 94	479 43	75
76	75 06	11 89	12 04	479 85	76 95	485 82	76
77	76 05	12 05	12 20	486 16	77 96	492 21	77
78	77 04	12 20	12 36	492 47	78 98	498 61	78
79	78 03	12 36	12 52	498 79	79 99	505 00	79
80	79 01	12 51	12 67	505 10	81 00	511 49	80
81	80 00	12 67	12 83	511 41	82 01	517 78	81
82	80 99	12 83	12 99	517 72	83 03	524 37	82
83	81 98	12 98	13 15	524 04	84 04	530 76	83
84	82 96	13 14	13 31	530 35	85 05	537 15	84
85	83 95	13 30	13 46	536 67	86 06	543 54	85
86	84 94	13 45	13 62	542 98	87 07	549 94	86
87	85 93	13 61	13 78	549 29	88 08	556 33	87
88	86 91	13 76	13 94	555 61	89 10	562 72	88
89	87 90	13 92	14 10	561 92	90 11	569 11	89
90	88 89	14 08	14 25	568 24	91 12	575 50	90
91	89 88	14 24	14 41	574 55	92 14	581 71	91
92	90 86	14 40	14 57	580 86	93 15	588 11	92
93	91 85	14 55	14 73	587 18	94 16	594 50	93
94	92 84	14 71	14 89	593 49	95 17	600 89	94
95	93 83	14 86	15 04	599 80	96 19	607 28	95
96	94 82	15 02	15 20	606 11	97 20	613 68	96
97	95 80	15 18	15 36	612 43	98 21	620 07	97
98	96 79	15 34	15 52	618 75	99 22	626 46	98
99	97 78	15 49	15 68	625 06	100 24	632 86	99
100	98 77	15 64	15 84	631 37	101 25	639 25	100

Numbers	Sines Degrees		Tangents Degrees		Secants Degrees		Numbers
	N.pt	N. pts.	N.pt	N. pts	N.pt	N. pts	
	10	80	10	80	10	80	
1	0 98	0 17	0 18	05 67	01 02	05 76	1
2	1 97	0 35	0 35	11 34	02 03	11 52	2
3	2 95	0 52	0 53	17 01	03 05	17 28	3
4	3 94	0 69	0 70	22 68	04 06	23 04	4
5	4 92	0 87	0 88	28 36	05 08	28 80	5
6	5 91	1 04	1 06	34 03	06 09	34 55	6
7	6 89	1 22	1 23	39 70	07 11	40 31	7
8	7 88	1 39	1 41	45 37	08 12	46 07	8
9	8 86	1 56	1 59	51 04	09 14	51 83	9
10	9 85	1 74	1 76	56 71	10 15	57 59	10
11	10 83	1 91	1 94	62 38	11 17	63 34	11
12	11 81	2 08	2 11	68 06	12 18	69 10	12
13	12 80	2 26	2 29	73 73	13 20	74 86	13
14	13 78	2 43	2 47	79 40	14 22	80 62	14
15	14 77	2 61	2 64	85 07	15 23	86 38	15
16	15 75	2 78	2 82	90 74	16 25	92 14	16
17	16 74	2 95	3 00	96 41	17 26	97 90	17
18	17 72	3 12	3 17	102 08	18 28	103 66	18
19	18 71	3 30	3 34	107 75	19 29	109 42	19
20	19 70	3 47	3 53	113 43	20 31	115 18	20
21	20 68	3 64	3 71	119 10	21 32	120 94	21
22	21 67	3 82	3 89	124 77	22 33	126 70	22
23	22 65	3 99	4 06	130 44	23 35	132 45	23
24	23 64	4 16	4 24	136 11	24 36	138 21	24
25	24 62	4 34	4 41	141 78	25 38	143 97	25
26	25 61	4 51	4 59	147 46	26 39	149 73	26
27	26 59	4 68	4 76	153 13	27 41	155 49	27
28	27 58	4 86	4 94	158 80	28 42	161 24	28
29	28 56	5 03	5 11	164 47	29 44	167 00	29
30	29 54	5 21	5 29	170 14	30 46	172 76	30
31	30 53	5 38	5 47	175 81	31 48	178 52	31
32	31 51	5 55	5 64	181 48	32 49	184 28	32
33	32 50	5 72	5 82	187 16	33 51	190 04	33
34	33 48	5 90	6 00	192 83	34 53	195 80	34
35	34 47	6 07	6 17	198 50	35 54	201 55	35
36	35 45	6 24	6 35	204 17	36 56	207 31	36
37	36 44	6 42	6 53	209 84	37 57	213 07	37
38	37 42	6 59	6 71	215 51	38 59	218 83	38
39	38 41	6 77	6 88	221 18	39 60	224 59	39
40	39 39	6 95	7 05	226 85	40 62	230 35	40
41	40 38	7 12	7 23	232 53	41 63	236 10	41
42	41 37	7 29	7 41	238 20	42 64	241 86	42
43	42 35	7 47	7 59	243 87	43 66	247 62	43
44	43 34	7 64	7 76	249 54	44 67	253 38	44
45	44 32	7 82	7 94	255 21	45 69	259 14	45
46	45 31	7 98	8 11	260 88	46 70	264 90	46
47	46 29	8 15	8 29	266 56	47 72	270 66	47
48	47 28	8 32	8 46	272 23	48 73	276 42	48
49	48 26	8 50	8 64	277 90	49 75	282 18	49
50	49 24	8 68	8 82	283 56	50 77	287 94	50

Numbers	Sines Degrees		Tangents Degrees		Secants Degrees		Numbers
	N.pts	N.pts	N.pts	N.pts	N.pts	N.pts.	
	10	80	10	80	10	80	
51	50 33	8 85	9 00	289 24	51 78	293 70	51
52	51 21	9 02	9 18	294 91	52 80	299 45	52
53	52 20	9 19	9 35	300 58	53 81	305 21	53
54	53 18	9 37	9 53	306 26	54 83	310 97	54
55	54 17	9 55	9 71	311 94	55 85	316 73	55
56	55 15	9 72	9 89	317 60	56 86	322 49	56
57	56 14	9 89	10 06	323 27	57 88	328 24	57
58	57 12	10 07	10 24	328 94	58 89	333 00	58
59	58 11	10 24	10 41	334 61	59 91	339 76	59
60	59 09	10 42	10 58	340 28	60 93	345 53	60
61	60 08	10 59	10 76	345 95	61 94	351 29	61
62	61 07	10 77	10 94	351 63	62 96	357 05	62
63	62 05	10 94	11 11	357 30	63 97	362 81	63
64	63 04	11 12	11 29	362 97	64 99	368 56	64
65	64 02	11 29	11 47	368 64	66 00	374 32	65
66	65 01	11 46	11 64	374 31	67 02	380 08	66
67	65 99	11 64	11 82	379 98	68 03	385 84	67
68	66 98	11 81	12 00	385 66	69 05	391 60	68
69	67 96	11 98	12 17	391 33	70 06	397 35	69
70	68 94	12 16	12 34	396 99	71 08	403 12	70
71	69 93	12 33	12 53	402 66	72 09	408 87	71
72	70 91	12 51	12 71	408 33	73 11	414 63	72
73	71 89	12 68	12 89	414 00	74 12	420 39	73
74	72 88	12 85	13 06	419 67	75 14	426 15	74
75	73 86	13 02	13 24	425 34	76 15	431 91	75
76	74 85	13 20	13 41	431 01	77 17	437 67	76
77	75 83	13 37	13 59	436 68	78 18	443 43	77
78	76 82	13 54	13 76	442 36	79 20	449 19	78
79	77 80	13 72	13 94	448 03	80 22	454 94	79
80	78 78	13 89	14 11	453 70	81 23	460 70	80
81	79 77	14 06	14 29	459 37	82 25	466 46	81
82	80 76	14 24	14 47	465 04	83 26	472 22	82
83	81 74	14 41	14 64	470 71	84 28	477 98	83
84	82 73	14 58	14 82	476 38	85 29	483 74	84
85	83 71	14 76	15 00	482 06	86 31	489 50	85
86	84 70	14 93	15 18	487 73	87 32	495 25	86
87	85 68	15 11	15 35	493 40	88 33	501 01	87
88	86 67	15 28	15 53	499 07	89 35	506 77	88
89	87 65	15 45	15 71	504 74	90 37	512 53	89
90	88 63	15 63	15 87	510 42	91 39	518 29	90
91	89 61	15 80	16 05	516 09	92 40	524 05	91
92	90 60	15 97	16 23	521 76	93 41	529 81	92
93	91 58	16 14	16 41	527 43	94 42	535 56	93
94	92 57	16 32	16 59	533 10	95 44	541 32	94
95	93 55	16 49	16 76	538 77	96 46	547 08	95
96	94 54	16 67	15 94	544 45	97 48	552 84	96
97	95 52	16 85	17 11	550 12	98 49	558 60	97
98	96 51	17 02	17 29	555 79	99 51	564 36	98
99	97 49	17 19	17 46	561 46	100 53	570 11	99
100	98 48	17 36	17 63	567 13	101 54	575 87	100

7 Rumb is 78 deg. 45 min.

Numbers	Sines Degrees 11 N.pt	Sines Degrees 79 N.pt	Tangents Degrees 11 N. pt	Tangents Degrees 79 N. pts	Secants Degrees 11 N.pt	Secants Degrees 79 N. pts.	Numbers
1	00 98	00 19	00 19	05 14	01 02	05 24	1
2	01 96	00 38	00 39	10 29	02 04	10 48	2
3	02 94	00 57	00 58	15 43	03 06	15 72	3
4	03 93	00 76	00 78	20 58	04 07	20 96	4
5	04 91	00 95	00 97	25 72	05 09	26 20	5
6	05 89	01 14	01 17	30 87	06 11	31 45	6
7	06 87	01 34	01 36	36 01	07 13	36 69	7
8	07 85	01 53	01 56	41 16	08 15	41 93	8
9	08 83	01 72	01 75	46 30	09 17	47 17	9
10	09 82	01 91	01 94	51 45	10 19	52 41	10
11	10 80	02 10	02 14	56 59	11 21	57 65	11
12	11 78	02 29	02 33	61 74	12 22	62 89	12
13	12 76	02 48	02 53	66 88	13 24	68 13	13
14	13 74	02 67	02 72	72 03	14 26	73 37	14
15	14 72	02 86	02 92	77 17	15 28	78 61	15
16	15 70	03 05	03 11	82 32	16 30	83 85	16
17	16 69	03 24	03 31	87 46	17 32	89 09	17
18	17 67	03 43	03 50	92 61	18 34	94 33	18
19	18 65	03 62	03 70	97 75	19 36	99 57	19
20	19 63	03 82	03 89	102 89	20 37	104 82	20
21	20 62	04 01	04 08	108 04	21 39	110 06	21
22	21 60	04 20	04 28	113 18	22 41	115 30	22
23	22 58	04 39	04 47	118 33	23 43	120 54	23
24	23 56	04 58	04 67	123 47	24 45	125 78	24
25	24 54	04 77	04 86	128 62	25 47	131 02	25
26	25 52	04 96	05 06	133 76	26 49	136 26	26
27	26 50	05 15	05 25	138 91	27 51	141 50	27
28	27 49	05 34	05 45	144 05	28 52	146 74	28
29	28 47	05 53	05 64	149 20	29 54	151 98	29
30	29 45	05 72	05 83	154 34	30 56	157 23	30
31	30 43	05 92	06 03	159 48	31 58	162 47	31
32	31 42	06 11	06 22	164 62	32 60	167 71	32
33	32 40	06 30	06 42	169 77	33 62	172 95	33
34	33 38	06 49	06 61	174 92	34 64	178 19	34
35	34 36	06 68	06 81	180 06	35 66	183 43	35
36	35 34	06 87	07 00	185 20	36 67	188 67	36
37	36 32	07 06	07 20	190 35	37 69	193 91	37
38	37 30	07 25	07 39	195 49	38 71	199 15	38
39	38 29	07 44	07 59	200 64	39 73	204 39	39
40	39 27	07 63	07 78	205 78	40 75	209 63	40
41	40 25	07 83	07 97	210 93	41 77	214 87	41
42	41 23	08 02	08 17	216 07	42 79	220 11	42
43	42 22	08 21	08 36	221 22	43 81	225 35	43
44	43 20	08 40	08 56	226 36	44 82	230 59	44
45	44 18	08 59	08 75	231 51	45 84	235 83	45
46	45 16	08 78	08 95	236 65	46 86	241 07	46
47	46 14	08 97	09 14	241 80	47 88	246 31	47
48	47 12	09 16	09 34	246 94	48 90	251 55	48
49	48 10	09 35	09 53	252 09	49 92	256 79	49
50	49 08	09 54	09 72	257 23	50 94	262 04	50

1 Rumb is 11 deg. 15 min.

Numbers	Sines Degrees 11 N.pt.	Sines Degrees 79 N.pt.	Tangents Degrees 11 N.pt.	Tangents Degrees 79 N.pts.	Secants Degrees 11 N.pt.	Secants Degrees 79 N.pts.	Numbers
51	50 06	09 74	09 92	262 37	51 96	267 28	51
52	51 04	09 93	10 11	267 51	52 98	272 52	52
53	52 03	10 12	10 31	272 64	54 00	277 76	53
54	53 01	10 31	10 50	277 80	55 01	283 00	54
55	54 00	10 50	10 70	282 94	56 03	288 24	55
56	54 98	10 69	10 89	288 09	57 05	293 48	56
57	55 96	10 88	11 09	293 23	58 07	298 72	57
58	56 94	11 07	11 28	298 38	59 09	303 96	58
59	57 92	11 26	11 47	303 52	60 11	309 20	59
60	58 90	11 45	11 66	308 67	61 12	314 45	60
61	59 88	11 65	11 86	313 81	62 14	319 69	61
62	60 86	11 84	12 05	318 96	63 16	324 93	62
63	61 84	12 03	12 25	324 10	64 18	330 17	63
64	62 82	12 22	12 44	329 25	65 20	335 41	64
65	63 80	12 41	12 64	334 40	66 22	340 65	65
66	64 79	12 60	12 83	339 54	67 24	345 89	66
67	65 77	12 79	13 03	344 69	68 26	351 13	67
68	66 75	12 98	13 22	349 83	69 28	356 37	68
69	67 73	13 17	13 42	354 98	70 30	361 61	69
70	68 71	13 36	13 61	360 12	71 31	366 86	70
71	69 70	13 55	13 81	365 25	72 33	372 10	71
72	70 68	13 74	14 02	370 40	73 35	377 34	72
73	71 66	13 93	14 22	375 54	74 37	382 58	73
74	72 64	14 12	14 39	380 69	75 39	387 82	74
75	73 62	14 31	14 59	385 83	76 41	393 06	75
76	74 60	14 50	14 78	390 98	77 43	398 30	76
77	75 59	14 69	14 98	396 08 12	78 45	403 54	77
78	76 57	14 88	15 17	401 27	79 47	408 78	78
79	77 55	15 07	15 36	406 42	80 49	414 02	79
80	78 53	15 26	15 55	411 56	81 50	419 27	80
81	79 52	15 46	15 75	416 71	82 51	424 51	81
82	80 50	15 65	15 94	421 85	83 53	429 75	82
83	81 48	15 84	16 14	427 00	84 55	434 99	83
84	82 46	16 03	16 36	432 14	85 57	440 23	84
85	83 44	16 22	16 53	437 29	86 59	445 47	85
86	84 42	16 41	16 72	442 43	87 60	450 71	86
87	85 40	16 60	16 92	447 58	88 62	455 95	87
88	86 39	16 78	17 11	452 72	89 64	461 19	88
89	87 37	16 98	17 30	457 87	90 66	466 43	89
90	88 35	17 17	17 49	463 01	91 68	471 68	90
91	89 33	17 37	17 68	468 15	92 70	476 92	91
92	90 32	17 56	17 88	473 29	93 72	482 16	92
93	91 30	17 75	18 07	478 44	94 74	487 40	93
94	92 28	17 94	18 27	483 58	95 76	492 64	94
95	93 26	18 13	18 46	488 73	96 78	497 88	95
96	94 24	18 32	18 66	493 87	97 80	503 12	96
97	95 22	18 51	18 85	499 01	98 82	508 35	97
98	96 20	18 70	19 05	504 16	99 84	513 60	98
99	97 18	18 89	19 24	509 31	100 86	518 84	99
100	98 16	19 08	19 44	514 45	101 87	524 08	100

1 Rumb is 11 deg. 15 min.

Numbers	Sines Degrees 12 N. pt	Sines Degrees 12 differences	Sines Degrees 78 N. pt	Sines Degrees 78 differences	Tangents Degrees 12 N. pt	Tangents Degrees 12 differences	Tangents Degrees 78 N. pts	Tangents Degrees 78 differences	Secants Degrees 12 N. pt	Secants Degrees 12 differences	Secants Degrees 78 N. pts	Secants Degrees 78 differences	Numbers
1	00 98	01	00 21	20	00 21	00	04 70	04	01 02	00	04 81	04	1
2	01 96	02	00 42	21	00 43	00	09 41	04	02 04	00	09 62	04	2
3	02 93	03	00 62	20	00 64	00	14 11	04	03 07	00	14 43	04	3
4	03 91	04	00 83	21	00 85	00	18 82	04	04 09	00	19 24	04	4
5	04 89	04	01 04	21	01 06	00	23 52	04	05 11	00	24 05	04	5
6	05 87	04	01 25	21	01 28	00	28 23	04	06 13	00	28 86	04	6
7	06 85	04	01 46	21	01 49	00	32 93	04	07 16	00	33 67	04	7
8	07 83	04	01 66	20	01 70	00	37 64	04	08 18	00	38 47	04	8
9	08 80	04	01 87	21	01 91	00	42 34	04	09 20	00	43 28	04	9
10	09 78	04	02 08	21	02 13	00	47 05	04	10 22	00	48 09	04	10
11	10 76	04	02 29	21	02 34	00	51 75	04	11 24	00	52 90	04	11
12	11 73	04	02 50	21	02 55	00	56 46	04	12 27	00	57 71	04	12
13	12 71	04	02 70	20	02 76	00	61 16	04	13 29	00	62 52	04	13
14	13 69	04	02 91	21	02 98	00	65 87	04	14 31	00	67 33	04	14
15	14 67	04	03 12	21	03 19	00	70 57	04	15 34	00	72 14	04	15
16	15 65	04	03 33	21	03 40	00	75 27	04	16 36	00	76 95	04	16
17	16 63	04	03 54	21	03 61	00	79 98	04	17 38	00	81 76	04	17
18	17 60	04	03 74	20	03 83	00	84 68	04	18 40	00	86 57	04	18
19	18 58	04	03 95	21	04 04	00	89 39	04	19 42	00	91 38	04	19
20	19 56	04	04 16	21	04 25	00	94 09	04	20 45	00	96 19	04	20
21	20 53	04	04 37	21	04 46	00	98 79	04	21 47	00	101 00	04	21
22	21 51	04	04 58	21	04 68	00	103 50	04	22 50	00	105 81	04	22
23	22 49	04	04 78	20	04 89	00	108 20	04	23 52	00	110 62	04	23
24	23 47	04	04 99	21	05 10	00	112 91	04	24 54	00	115 43	04	24
25	24 45	05	05 20	21	05 31	00	117 61	04	25 56	00	120 24	04	25
26	25 43	05	05 41	21	05 53	00	122 32	04	26 58	00	125 05	04	26
27	26 40	05	05 61	20	06 74	00	127 02	04	27 60	00	129 86	04	27
28	27 38	05	05 82	21	06 95	00	131 73	04	28 63	00	134 67	04	28
29	28 36	06	06 03	21	06 16	00	136 43	04	29 65	00	139 48	04	29
30	29 34	06	06 24	21	06 38	00	141 14	04	30 67	00	144 28	04	30
31	30 31	06	06 45	21	06 59	00	145 84	04	31 70	00	149 09	04	31
32	31 29	06	06 65	20	06 80	00	150 55	04	32 72	00	153 90	04	32
33	32 27	06	06 86	21	07 01	00	155 25	04	33 74	00	158 71	04	33
34	33 25	07	07 07	21	07 23	00	159 96	04	34 76	00	163 52	04	34
35	34 23	07	07 28	21	07 44	00	164 66	04	35 78	00	168 33	04	35
36	35 20	07	07 49	21	07 55	00	169 37	04	36 80	00	173 14	04	36
37	36 18	07	07 70	21	07 86	00	174 07	04	37 83	00	177 95	04	37
38	37 16	07	07 90	20	08 08	00	178 78	04	38 85	00	182 76	04	38
39	38 14	08	08 11	21	08 29	00	183 48	04	39 87	00	187 57	04	39
40	39 12	08	08 32	21	08 50	00	188 19	04	40 89	00	192 37	04	40
41	40 10	08	08 53	21	08 71	00	192 89	04	41 91	00	197 18	04	41
42	41 08	08	08 74	21	08 93	00	197 60	04	42 93	00	201 99	04	42
43	42 06	08	08 94	20	09 14	00	202 30	04	43 95	00	206 80	04	43
44	43 04	09	09 15	21	09 35	00	207 01	04	44 98	00	211 61	04	44
45	44 02	09	09 36	21	09 56	00	211 71	04	46 00	00	216 42	04	45
46	45 00	09	09 57	21	09 78	00	216 42	04	47 02	00	221 23	04	46
47	45 98	09	09 78	21	09 99	00	221 12	04	48 05	00	226 04	04	47
48	46 96	09	09 98	20	10 20	00	225 82	04	49 07	00	230 85	04	48
49	47 93	10	10 19	21	10 41	00	230 53	04	50 09	00	235 66	04	49
50	48 91	10	10 40	21	10 63	00	235 23	04	51 12	00	240 47	04	50

Numbers	Sines Degrees 12 N.pt.	Sines Degrees 78 N.pt.	Tangents Degrees 12 N.pt.	Tangents Degrees 78 N.pts.	Secants Degrees 12 N.pt.	Secants Degrees 78 N.pts.	Numbers
51	49 89	10 60	10 84	239 94	52 14	245 28	51
52	50 87	10 81	11 05	244 64	53 16	250 09	52
53	51 85	11 02	11 26	249 35	54 18	254 90	53
54	52 83	11 23	11 48	254 05	55 20	259 71	54
55	53 80	11 44	11 69	258 76	56 23	264 52	55
56	54 78	11 64	11 90	263 46	57 25	269 33	56
57	55 76	11 85	12 11	268 17	58 28	274 14	57
58	56 73	12 06	12 33	272 87	59 30	278 95	58
59	57 71	12 26	12 54	277 58	60 32	283 75	59
60	58 69	12 47	12 75	282 28	61 34	288 56	60
61	59 67	12 67	12 96	286 98	62 36	293 37	61
62	60 65	12 88	13 18	291 69	63 38	298 18	62
63	61 63	13 09	13 39	296 39	64 40	302 99	63
64	62 60	13 30	13 60	301 10	65 42	307 80	64
65	63 58	13 51	13 81	305 80	66 45	312 61	65
66	64 56	13 71	14 03	310 50	67 47	317 42	66
67	65 53	13 92	14 24	315 21	68 50	322 23	67
68	66 51	14 13	14 45	319 91	69 52	327 04	68
69	67 49	14 34	14 66	324 62	70 54	331 85	69
70	68 47	14 55	14 88	329 32	71 56	336 66	70
71	69 45	14 76	15 09	334 03	72 58	341 47	71
72	70 43	14 97	15 30	338 73	73 60	346 28	72
73	71 40	15 18	15 51	343 44	74 63	351 09	73
74	72 38	15 39	15 73	348 14	75 65	355 90	74
75	73 36	15 60	15 94	352 85	76 67	360 71	75
76	74 34	15 81	16 15	357 55	77 70	365 52	76
77	75 31	16 01	16 36	362 26	78 72	370 32	77
78	76 29	16 22	16 58	366 96	79 74	375 13	78
79	77 27	16 43	16 79	371 67	80 76	379 94	79
80	78 25	16 63	17 00	376 37	81 78	384 75	80
81	79 23	16 84	17 21	381 08	82 80	389 56	81
82	80 20	17 05	17 43	385 78	83 83	394 37	82
83	81 18	17 25	17 64	390 49	84 85	399 18	83
84	82 16	17 46	17 85	395 19	85 87	403 99	84
85	83 14	17 67	18 06	399 90	86 89	408 80	85
86	84 12	17 88	18 28	404 60	87 91	413 61	86
87	85 10	18 09	18 49	409 31	88 93	418 42	87
88	86 08	18 30	18 70	414 01	89 95	423 23	88
89	87 06	18 50	18 91	418 72	90 98	428 04	89
90	88 03	18 71	19 13	423 42	92 01	432 84	90
91	89 01	18 92	19 34	428 13	93 03	437 65	91
92	89 99	19 13	19 55	432 83	94 05	442 46	92
93	90 97	19 33	19 76	437 54	95 07	447 27	93
94	91 95	19 54	19 98	442 24	96 09	452 08	94
95	92 93	19 75	20 19	446 95	97 12	456 89	95
96	93 90	19 96	20 40	451 65	98 14	461 70	96
97	94 88	20 17	20 61	456 35	99 16	466 51	97
98	95 86	20 37	20 83	461 06	100 18	471 32	98
99	96 84	20 58	21 04	465 76	101 20	476 13	99
100	97 81	20 79	21 26	470 46	102 23	480 94	100

Numbers	Sines Degrees 13 N.pt.		77 N.pt.		Tangents Degrees 13 N.pt.		77 N.pts.		Secants Degrees 13 N.pt.		77 N.pts.		Numbers
1	00	97	00	22	00	23	04	33	01	02	04	45	1
2	01	95	00	45	00	46	08	66	02	05	08	89	2
3	02	92	00	67	00	69	13	99	03	08	13	34	3
4	03	90	00	90	00	92	17	33	04	10	17	78	4
5	04	87	01	12	01	15	21	66	05	13	22	23	5
6	05	85	01	35	01	39	25	99	06	16	26	66	6
7	06	82	01	57	01	62	30	32	07	18	31	12	7
8	07	79	01	80	01	85	34	65	08	21	35	56	8
9	08	77	02	02	02	08	38	98	09	24	40	01	9
10	09	74	02	25	02	31	43	31	10	26	44	45	10
11	10	71	02	47	02	54	47	64	11	29	48	89	11
12	11	69	02	70	02	77	51	97	12	31	53	34	12
13	12	66	02	92	03	00	56	30	13	34	57	78	13
14	13	64	03	15	03	23	60	63	14	36	62	23	14
15	14	61	03	37	03	47	64	96	15	39	66	66	15
16	15	58	03	60	03	70	69	30	16	42	71	12	16
17	16	56	03	81	03	93	73	63	17	45	75	55	17
18	17	53	04	05	04	16	77	96	18	47	80	01	18
19	18	51	04	27	04	39	82	30	19	50	84	46	19
20	19	48	04	50	04	62	86	63	20	53	88	91	20
21	20	46	04	72	04	85	90	96	21	55	93	36	21
22	21	43	04	95	05	08	95	29	22	58	97	80	22
23	22	40	05	17	05	31	99	62	23	60	102	25	23
24	23	37	05	40	05	54	103	95	24	63	106	68	24
25	24	35	05	62	05	77	108	28	25	66	111	14	25
26	25	32	05	85	06	00	112	61	26	68	115	58	26
27	26	30	06	07	06	23	116	94	27	71	120	03	27
28	27	27	06	30	06	46	121	27	28	74	124	47	28
29	28	25	06	52	06	69	125	60	29	76	128	91	29
30	29	23	06	75	06	92	129	94	30	79	133	36	30
31	30	20	06	47	07	15	134	27	31	81	137	82	31
32	31	17	07	20	07	39	138	60	32	84	142	27	32
33	32	15	07	42	07	62	142	93	33	86	146	72	33
34	33	12	07	65	07	85	147	26	34	89	151	16	34
35	34	10	07	87	08	08	151	60	35	92	155	60	35
36	35	07	08	10	08	31	155	93	36	95	160	05	36
37	36	05	08	32	08	54	160	26	37	97	164	49	37
38	37	02	08	55	08	77	164	60	39	00	168	93	38
39	38	00	08	77	09	00	168	93	40	03	173	38	39
40	38	97	09	00	09	23	173	26	41	05	177	82	40
41	39	95	09	22	09	46	177	60	42	08	182	27	41
42	40	92	09	45	09	69	181	93	43	10	186	70	42
43	41	90	09	67	09	92	186	26	44	13	191	16	43
44	42	87	09	90	10	15	190	59	45	16	195	60	44
45	43	85	10	12	10	38	194	92	46	18	200	05	45
46	44	82	10	35	10	62	199	25	47	21	204	49	46
47	45	80	10	57	10	85	203	58	48	24	208	93	47
48	46	78	10	80	11	08	207	91	49	26	213	38	48
49	47	75	11	02	11	31	212	24	50	29	217	82	49
50	48	72	11	25	11	54	216	57	51	32	222	27	50

Numbers	Sines Degrees 13 N.pt.	Sines Degrees 77 N.pt.	Tangents Degrees 13 N.pts.	Tangents Degrees 77 N.pts.	Secants Degrees 13 N.pt.	Secants Degrees 77 N.pts.	Numbers
51	49 69	11 47	11 77	220 90	52 34	226 71	51
52	50 66	11 70	12 00	225 23	53 36	231 15	52
53	51 64	11 92	12 23	229 56	54 39	235 59	53
54	52 61	12 15	12 46	233 89	55 42	240 04	54
55	53 58	12 37	12 69	238 23	56 45	244 48	55
56	54 55	12 60	12 92	242 56	57 47	248 93	56
57	55 52	12 82	13 15	246 89	58 50	253 36	57
58	56 50	13 05	13 39	251 23	59 53	257 82	58
59	57 48	13 27	13 62	255 56	60 55	262 26	59
60	58 46	13 50	13 85	259 89	61 58	266 72	60
61	59 43	13 72	14 08	264 22	62 60	271 16	61
62	60 40	13 95	14 31	268 55	63 63	275 61	62
63	61 38	14 17	14 54	272 88	64 66	280 05	63
64	62 35	14 40	14 77	277 21	65 68	284 50	64
65	63 33	14 62	15 00	281 54	66 71	288 94	65
66	64 30	14 85	15 23	285 87	67 74	293 39	66
67	65 28	15 07	15 47	290 20	68 76	297 83	67
68	66 25	15 30	15 70	294 53	69 79	302 28	68
69	67 23	15 52	15 93	298 86	70 81	306 73	69
70	68 20	15 75	16 16	303 20	71 84	311 18	70
71	69 17	15 97	16 39	307 53	72 86	315 62	71
72	70 15	16 20	16 62	311 86	73 89	320 07	72
73	71 12	16 42	16 85	316 20	74 91	324 52	73
74	72 10	16 65	17 08	320 53	75 94	328 96	74
75	73 07	16 87	17 31	324 86	76 97	333 40	75
76	74 05	17 10	17 54	329 20	78 00	337 85	76
77	75 02	17 32	17 77	333 53	79 02	342 29	77
78	76 00	17 55	18 00	337 86	80 05	346 74	78
79	76 97	17 77	18 23	342 19	81 08	351 18	79
80	77 95	18 00	18 47	346 52	82 10	355 63	80
81	78 92	18 22	18 69	350 85	83 13	360 07	81
82	79 90	18 45	18 92	355 18	84 16	364 52	82
83	80 87	18 67	19 15	359 51	85 18	368 96	83
84	81 85	18 90	19 39	363 84	86 21	373 40	84
85	82 82	19 12	19 62	368 17	87 24	377 85	85
86	83 80	19 35	19 85	372 50	88 26	382 29	86
87	84 77	19 57	20 08	376 83	89 29	386 74	87
88	85 75	19 80	20 31	381 16	90 31	391 19	88
89	86 72	20 02	20 54	385 50	91 34	395 64	89
90	87 69	20 25	20 78	389 83	92 37	400 09	90
91	88 67	20 47	21 00	394 16	93 39	404 54	91
92	89 65	20 70	21 23	398 50	94 42	408 98	92
93	90 62	20 92	21 47	402 83	95 45	413 43	93
94	91 60	21 15	21 70	407 16	96 47	417 88	94
95	92 57	21 37	21 93	411 50	97 50	422 32	95
96	93 55	21 60	22 16	415 83	98 53	426 76	96
97	94 52	21 80	22 40	420 16	99 55	431 20	97
98	95 50	22 05	22 63	424 49	100 58	435 65	98
99	96 47	22 27	22 86	428 82	101 60	440 09	99
100	97 44	22 50	23 09	433 15	102 63	444 54	100

6 Rumb and three quarters is 75 deg. 56 m.

Numbers	Sines Degrees 14 N. pt	Sines Degrees 14 difference	Sines Degrees 76 N. pt	Sines Degrees 76 difference	Tangents Degrees 14 N. pt	Tangents Degrees 14 difference	Tangents Degrees 76 N. pts	Tangents Degrees 76 difference	Secants Degrees 14 N. pt	Secants Degrees 14 difference	Secants Degrees 76 N pts.	Secants Degrees 76 difference	Numbers
1	00 97		00 24		00 25		04 01		01 03		0 13		1
2	01 94	3	00 48	24	00 50	25	08 02	4 01	02 06	3	08 26	13	2
3	02 91	3	00 73	25	00 75	25	12 03	4 01	03 08	2	12 40	14	3
4	03 88	3	00 97	24	01 00	25	16 04	4 01	04 12	4	16 53	13	4
5	04 85	3	01 21	24	01 25	25	20 05	4 01	05 15	3	20 67	14	5
6	05 82	3	01 45	24	01 50	25	24 06	4 01	06 18	3	24 80	13	6
7	06 79	3	01 69	24	01 75	25	28 08	4 02	07 21	3	28 94	14	7
8	07 76	3	01 94	25	02 00	25	32 09	4 01	08 24	3	33 07	13	8
9	08 73	3	02 18	24	02 24	24	36 10	4 01	09 28	4	37 20	13	9
10	09 70	3	02 42	24	02 49	25	40 11	4 01	10 31	3	41 33	13	10
11	10 67	3	02 66	24	02 74	25	44 12	4 01	11 34	3	45 46	13	11
12	11 64	3	02 90	24	02 99	25	48 13	4 01	12 37	3	49 60	14	12
13	12 61	3	03 15	25	03 24	25	52 14	4 02	13 40	3	53 73	13	13
14	13 58	3	03 39	24	03 49	25	56 15	4 01	14 43	3	57 86	13	14
15	14 55	3	03 63	24	03 74	25	60 16	4 01	15 46	3	62 00	14	15
16	15 52	3	03 87	24	03 99	25	64 17	4 01	16 49	3	66 13	13	16
17	16 49	3	04 11	24	04 24	25	68 18	4 01	17 52	3	70 26	13	17
18	17 46	3	04 36	25	04 49	25	72 19	4 01	18 55	3	74 40	14	18
19	18 43	3	04 60	24	04 74	25	76 20	4 01	19 58	3	78 53	13	19
20	19 41	2	04 84	24	04 99	25	80 22	4 02	20 61	3	82 67	14	20
21	20 38	3	05 08	24	05 23	24	84 23	4 01	21 64	3	86 80	13	21
22	21 35	3	05 33	25	05 48	25	88 24	4 01	22 67	3	90 93	13	22
23	22 32	3	05 57	24	05 73	25	92 25	4 01	23 70	3	95 07	14	23
24	23 29	3	05 81	24	05 98	25	96 26	4 01	24 73	3	99 20	13	24
25	24 26	3	06 05	24	06 23	25	100 27	4 01	25 76	3	103 33	13	25
26	25 23	3	06 29	24	06 48	25	104 28	4 01	26 80	4	107 47	14	26
27	26 20	3	06 54	25	06 73	25	108 29	4 01	27 83	3	111 60	13	27
28	27 17	3	06 78	24	06 98	25	112 30	4 01	28 86	3	115 73	13	28
29	28 14	3	07 02	24	07 23	25	116 31	4 01	29 89	3	119 87	14	29
30	29 11	3	07 26	24	07 48	25	120 32	4 01	30 92	3	124 01	14	30
31	30 08	3	07 50	24	07 73	25	124 33	4 01	31 95	3	128 14	13	31
32	31 05	3	07 75	25	07 98	25	128 34	4 01	32 98	3	132 27	13	32
33	32 02	3	07 99	24	08 22	24	132 35	4 01	34 01	3	136 40	13	33
34	32 99	3	08 23	24	08 48	26	136 36	4 01	35 04	3	140 54	14	34
35	33 96	3	08 47	24	08 73	25	140 38	4 02	36 07	3	144 67	13	35
36	34 93	3	08 71	24	08 98	25	144 39	4 01	37 10	3	148 80	13	36
37	35 90	3	08 96	25	09 23	25	148 40	4 01	38 13	3	152 94	14	37
38	36 87	3	09 20	24	09 48	25	152 41	4 01	39 16	3	157 07	13	38
39	37 84	3	09 44	24	09 73	25	156 42	4 01	40 19	3	161 20	13	39
40	38 81	3	09 68	24	09 97	24	160 43	4 01	41 22	3	165 34	14	40
41	39 78	3	09 93	25	10 22	25	164 44	4 01	42 25	3	169 47	13	41
42	40 75	3	10 17	24	10 47	25	168 45	4 01	43 28	3	173 60	13	42
43	41 72	3	10 41	24	10 72	25	172 46	4 01	44 31	3	177 74	14	43
44	42 69	3	10 65	24	10 97	25	176 47	4 01	45 34	3	181 87	13	44
45	43 66	3	10 89	24	11 22	25	180 48	4 01	46 37	3	186 00	13	45
46	44 63	3	11 14	25	11 47	25	184 49	4 01	47 40	3	190 14	14	46
47	45 60	3	11 38	24	11 72	25	188 50	4 01	48 43	3	194 27	13	47
48	46 57	3	11 62	24	11 97	25	192 51	4 01	49 46	3	198 40	13	48
49	47 54	3	11 86	24	12 22	25	196 52	4 01	50 50	4	202 54	14	49
50	48 51	3	12 10	24	12 47	25	200 54	4 02	51 53	3	206 68	14	50

3 Rumb and a quarter is 14 deg. 4 min.

Numbers	Sines Degrees 14 N.	pt.	76 N.	pt.	Tangents Degrees 14 N.	pt.	76 N.	pts.	Secants Degrees 14 N.	pt.	76 N.	pts.	Numbers
51	49	49	12	34	12	71	204	55	52	56	210	83	51
52	50	46	12	58	12	95	208	56	53	59	214	94	52
53	51	43	12	83	13	21	212	57	54	62	219	07	53
54	52	40	13	07	13	46	216	58	55	65	223	20	54
55	53	37	13	31	13	71	220	59	56	68	227	34	55
56	54	34	13	55	13	96	224	60	57	71	231	47	56
57	55	31	13	79	14	21	228	61	58	74	235	60	57
58	56	28	14	04	14	46	232	62	59	77	239	74	58
59	57	25	14	28	14	71	236	63	60	80	243	87	59
60	58	22	14	52	14	96	240	65	61	84	248	01	60
61	59	19	14	76	15	21	244	66	62	87	252	15	61
62	60	16	15	00	15	46	248	67	63	90	256	28	62
63	61	13	15	24	15	71	252	68	64	93	260	41	63
64	62	10	15	48	15	96	256	69	65	96	264	55	64
65	63	07	15	73	16	21	260	70	66	99	268	68	65
66	64	04	15	97	16	46	264	71	68	02	272	81	66
67	65	01	16	21	16	70	268	72	69	05	276	95	67
68	65	98	16	45	16	95	272	73	70	08	281	08	68
69	66	95	16	69	17	20	276	74	71	11	285	21	69
70	67	92	16	93	17	45	280	75	72	14	289	35	70
71	68	89	17	17	17	70	284	76	73	17	293	48	71
72	69	86	17	41	17	95	288	77	74	20	297	61	72
73	70	83	17	65	18	20	292	78	75	23	301	75	73
74	71	80	17	89	18	45	296	80	76	26	305	88	74
75	72	77	18	14	18	70	300	81	77	30	310	01	75
76	73	74	18	38	18	95	304	82	78	33	314	15	76
77	74	71	18	62	19	20	308	83	79	36	318	28	77
78	75	68	18	86	19	45	312	84	80	39	322	41	78
79	76	65	19	10	19	70	316	85	81	42	326	55	79
80	77	62	19	35	19	95	320	86	82	45	330	69	80
81	78	60	19	39	20	20	324	87	83	48	334	82	81
82	79	57	19	84	20	45	328	88	84	51	338	95	82
83	80	54	20	08	20	70	332	89	85	54	343	09	83
84	81	51	20	32	20	95	336	90	86	57	347	22	84
85	82	48	20	56	21	19	340	92	87	60	351	35	85
86	83	45	20	80	21	44	344	93	88	63	355	46	86
87	84	42	21	05	21	69	348	94	89	66	359	62	87
88	85	39	21	29	21	94	352	95	90	69	363	75	88
89	86	36	21	53	22	19	356	96	91	72	367	89	89
90	87	33	21	77	22	44	360	97	92	75	372	02	90
91	88	30	22	01	22	69	364	98	93	78	376	15	91
92	89	27	22	25	22	94	368	99	94	82	380	29	92
93	90	24	22	49	23	19	373	00	95	85	384	42	93
94	91	21	22	74	23	44	377	01	96	88	388	56	94
95	92	18	22	98	23	68	381	02	97	91	392	69	95
96	93	15	23	23	23	93	385	03	98	94	396	83	96
97	94	12	23	46	24	18	389	04	99	97	400	96	97
98	95	09	23	70	24	43	393	06	101	00	405	09	98
99	96	06	23	94	24	68	397	07	102	03	409	23	99
100	97	03	24	19	24	93	401	08	103	06	413	36	100

1 Rumb and a quarter is 14 deg. 4 min.

Numbers	Sines Degrees 15 N. pt	Sines Degrees 15 Difference	Sines Degrees 75 N. pt	Sines Degrees 75 Difference	Tangents Degrees 15 N. pt	Tangents Degrees 15 Difference	Tangents Degrees 75 N. pts	Tangents Degrees 75 Difference	Secants Degrees 15 N. pt	Secants Degrees 15 Difference	Secants Degrees 75 N. pts.	Secants Degrees 75 Difference	Numbers
1	00 97	1	00 26	1	00 27	1	03 73	1	01 04	1	03 86	1	1
2	01 93	2	00 52	2	00 54	2	07 46	2	02 07	2	07 73	2	2
3	02 90	3	00 78	3	00 80	3	11 20	3	03 11	3	11 56	3	3
4	03 86	4	01 04	4	01 07	4	14 93	4	04 14	4	15 45	4	4
5	04 83	5	01 29	5	01 34	5	18 66	5	05 18	5	19 32	5	5
6	05 80	6	01 55	6	01 61	6	22 39	6	06 21	6	23 18	6	6
7	06 76	7	01 81	7	01 88	7	26 12	7	07 25	7	27 05	7	7
8	07 73	8	02 07	8	02 14	8	29 86	8	08 28	8	30 91	8	8
9	08 70	9	02 33	9	02 41	9	33 59	9	09 32	9	34 77	9	9
10	09 66	10	02 59	10	02 68	10	37 32	10	10 35	10	38 64	10	10
11	10 63	11	02 85	11	02 95	11	41 05	11	11 39	11	42 50	11	11
12	11 60	12	03 11	12	03 22	12	44 78	12	12 42	12	46 37	12	12
13	12 56	13	03 37	13	03 48	13	48 52	13	13 46	13	50 23	13	13
14	13 53	14	03 63	14	03 75	14	52 25	14	14 49	14	54 09	14	14
15	14 50	15	04 88	15	04 02	15	55 98	15	15 53	15	57 96	15	15
16	15 46	16	04 14	16	04 29	16	59 71	16	16 56	16	61 82	16	16
17	16 43	17	04 40	17	04 54	17	63 44	17	17 60	17	65 69	17	17
18	17 40	18	04 66	18	04 82	18	67 16	18	18 63	18	69 55	18	18
19	18 36	19	04 92	19	05 09	19	70 91	19	19 67	19	73 41	19	19
20	19 32	20	05 18	20	05 36	20	74 64	20	20 71	20	77 28	20	20
21	20 28	21	05 44	21	05 63	21	78 37	21	21 74	21	81 15	21	21
22	21 23	22	05 70	22	05 90	22	82 10	22	22 77	22	85 00	22	22
23	22 22	23	05 96	23	06 16	23	85 84	23	23 81	23	88 86	23	23
24	23 18	24	06 22	24	06 43	24	89 57	24	24 84	24	92 73	24	24
25	24 15	25	06 47	25	06 70	25	93 30	25	25 88	25	96 59	25	25
26	25 12	26	06 73	26	06 97	26	97 03	26	26 92	26	100 45	26	26
27	26 08	27	06 99	27	07 24	27	100 76	27	27 95	27	104 32	27	27
28	27 05	28	07 25	28	07 50	28	104 50	28	28 98	28	108 18	28	28
29	28 02	29	07 51	29	07 77	29	108 23	29	30 02	29	112 05	29	29
30	28 98	30	07 76	30	08 04	30	111 96	30	31 06	30	115 91	30	30
31	29 95	31	08 02	31	08 31	31	115 69	31	32 10	31	119 77	31	31
32	30 92	32	08 28	32	08 56	32	119 42	32	33 13	32	123 64	32	32
33	31 88	33	08 54	33	08 84	33	123 14	33	34 17	33	127 50	33	33
34	32 85	34	08 80	34	09 11	34	126 89	34	35 20	34	131 37	34	34
35	33 82	35	09 05	35	09 38	35	130 62	35	36 24	35	135 23	35	35
36	34 78	36	09 31	36	09 65	36	134 35	36	37 27	36	139 09	36	36
37	35 75	37	09 57	37	09 92	37	138 08	37	38 31	37	142 96	37	37
38	36 72	38	09 83	38	10 18	38	141 82	38	39 34	38	146 82	38	38
39	37 68	39	10 09	39	10 45	39	145 55	39	40 38	39	150 69	39	39
40	38 64	40	10 35	40	10 72	40	149 28	40	41 41	40	154 55	40	40
41	39 60	41	10 61	41	10 99	41	153 01	41	42 45	41	158 41	41	41
42	40 57	42	10 87	42	11 26	42	156 74	42	43 48	42	162 28	42	42
43	41 54	43	11 13	43	11 52	43	160 48	43	44 52	43	166 15	43	43
44	42 50	44	11 39	44	11 79	44	164 21	44	45 55	44	170 00	44	44
45	43 46	45	11 65	45	12 06	45	167 94	45	46 59	45	173 86	45	45
46	44 43	46	11 91	46	12 33	46	171 67	46	47 62	46	177 73	46	46
47	45 40	47	12 17	47	12 60	47	175 40	47	48 66	47	181 59	47	47
48	46 36	48	12 43	48	12 86	48	179 12	48	49 70	48	185 45	48	48
49	47 33	49	12 69	49	13 13	49	182 87	49	50 73	49	189 32	49	49
50	48 30	50	12 94	50	13 40	50	186 60	50	51 76	50	193 18	50	50

Numbers	Sines Degrees 15 N.pr.	Sines Degrees 75 N.pr.	Tangents Degrees 15 N.pr.	Tangents Degrees 75 N.pts.	Secants Degrees 15 N. pr.	Secants Degrees 75 N.pts.	Numbers
51	49 26	13 20	13 67	193 33	52 80	197 09	51
52	50 23	13 46	13 94	194 77	53 83	200 59	52
53	51 19	13 72	14 20	197 79	54 87	204 55	53
54	52 16	13 98	14 47	201 53	55 91	208 64	54
55	53 13	14 24	14 72	205 26	56 95	212 50	55
56	54 09	14 50	15 00	208 99	57 97	216 37	56
57	55 06	14 76	15 27	212 72	59 01	220 23	57
58	56 03	15 02	15 54	216 45	60 05	224 09	58
59	56 99	15 28	15 80	220 17	61 09	227 96	59
60	57 96	15 54	16 08	223 92	62 12	231 82	60
61	58 93	15 80	16 34	227 65	63 16	235 69	61
62	59 89	16 06	16 61	231 38	64 19	239 55	62
63	60 83	16 32	16 88	235 11	65 23	243 41	63
64	61 80	16 58	17 14	238 85	66 26	247 28	64
65	62 77	16 83	17 41	242 58	67 30	251 15	65
66	63 74	17 09	17 68	246 31	68 33	255 00	66
67	64 71	17 36	17 95	250 04	69 37	258 86	67
68	65 68	17 61	18 22	253 77	70 40	262 73	68
69	66 64	17 87	18 48	257 51	71 44	266 59	69
70	67 61	18 12	18 76	261 24	72 47	270 46	70
71	68 57	18 32	19 02	264 97	73 51	274 32	71
72	69 54	18 64	19 29	268 70	74 54	278 18	72
73	70 51	18 89	19 56	272 43	75 58	282 05	73
74	71 47	19 15	19 82	276 15	76 61	285 91	74
75	72 44	19 41	20 09	279 90	77 65	289 77	75
76	73 40	19 67	20 36	283 63	78 69	293 64	76
77	74 38	19 93	20 63	287 36	79 72	297 50	77
78	75 34	20 19	20 90	291 09	80 75	301 37	78
79	76 30	20 45	21 16	294 83	81 79	305 23	79
80	77 27	20 71	21 44	298 56	82 82	309 10	80
81	78 23	20 97	21 70	302 29	83 86	312 96	81
82	79 20	21 23	21 97	306 02	84 90	316 82	82
83	80 16	21 49	22 24	309 75	85 93	320 69	83
84	81 13	21 75	22 50	313 49	86 96	324 55	84
85	82 10	22 00	22 77	317 22	88 00	328 41	85
86	83 06	22 26	23 04	320 95	89 04	332 28	86
87	84 03	22 52	23 31	324 68	90 07	336 15	87
88	84 99	22 78	23 56	328 41	91 11	340 00	88
89	85 96	23 04	23 84	332 14	92 14	343 86	89
90	86 93	23 29	24 12	335 88	93 18	347 73	90
91	87 90	23 55	24 38	339 61	94 21	351 59	91
92	88 86	23 81	24 65	343 34	95 25	355 45	92
93	89 83	24 07	24 92	347 07	96 28	359 32	93
94	90 80	24 33	25 18	350 80	97 32	363 18	94
95	91 76	24 59	25 45	354 54	98 35	367 05	95
96	92 73	24 85	25 72	358 27	99 39	370 91	96
97	93 70	25 11	25 99	362 00	100 42	374 77	97
98	94 66	25 37	26 26	365 73	101 46	378 64	98
99	95 63	25 63	26 52	369 46	102 49	382 50	99
100	96 59	25 88	26 80	373 20	103 53	386 37	100

Numbers	Sines Degrees 16 N.pt	Sines Degrees 74 N.pt	Tangents Degrees 16 N.pt.	Tangents Degrees 74 N.pts.	Secants Degrees 16 N.pt	Secants Degrees 74 N.pts.	Numbers
1	00 96	00 28	00 29	03 49	01 04	03 63	1
2	01 92	00 55	00 57	06 97	02 08	07 26	2
3	02 88	00 83	00 86	10 46	03 11	10 88	3
4	03 85	01 10	01 15	13 95	04 16	14 51	4
5	04 81	01 38	01 43	17 44	05 20	18 14	5
6	05 77	01 65	01 72	20 92	06 24	21 77	6
7	06 73	01 93	02 01	24 41	07 28	25 40	7
8	07 69	02 20	02 29	27 90	08 32	29 03	8
9	08 65	02 48	02 58	31 39	09 36	32 65	9
10	09 61	02 76	02 87	34 87	10 40	36 28	10
11	10 57	03 04	03 16	38 36	11 44	39 90	11
12	11 53	03 31	03 44	41 85	12 48	43 53	12
13	12 49	03 59	03 73	45 34	13 52	47 16	13
14	13 46	04 86	04 01	48 82	14 56	50 79	14
15	14 42	04 14	04 30	52 31	15 60	54 42	15
16	15 38	04 41	04 59	55 80	16 64	58 04	16
17	16 34	04 69	04 87	59 29	17 68	61 67	17
18	17 30	04 96	05 16	62 77	18 72	65 30	18
19	18 26	05 24	05 45	66 26	19 76	68 92	19
20	19 23	05 51	05 73	69 75	20 81	72 56	20
21	20 18	05 79	06 02	73 24	21 85	76 18	21
22	21 14	06 06	06 30	76 72	22 89	79 81	22
23	22 10	06 34	06 59	80 21	23 93	83 44	23
24	23 07	06 61	06 88	83 70	24 97	87 06	24
25	24 03	06 89	07 17	87 19	26 01	90 69	25
26	24 99	07 17	07 45	90 67	27 05	94 32	26
27	25 95	07 44	07 74	94 16	28 09	97 94	27
28	26 91	07 72	08 02	97 65	29 13	101 57	28
29	27 87	07 99	08 31	101 14	30 17	105 20	29
30	28 84	08 27	08 60	104 62	31 21	108 84	30
31	29 80	08 54	08 88	108 11	32 25	112 46	31
32	30 76	08 82	09 17	111 60	33 29	116 08	32
33	31 72	09 09	09 46	115 09	34 33	119 71	33
34	32 68	09 37	09 74	118 57	35 37	123 34	34
35	33 64	09 64	10 03	122 06	36 41	126 96	35
36	34 60	09 92	10 31	125 55	37 45	130 59	36
37	35 56	10 19	10 60	129 04	38 49	134 22	37
38	36 52	10 47	10 89	132 52	39 53	137 86	38
39	37 48	10 75	11 18	136 01	40 57	141 48	39
40	38 45	11 03	11 47	139 50	41 61	145 12	40
41	39 41	11 30	11 75	142 99	42 65	148 74	41
42	40 37	11 58	12 03	146 47	43 69	152 37	42
43	41 33	11 85	12 32	149 96	44 73	155 98	43
44	42 29	12 13	12 61	153 45	45 77	159 61	44
45	43 25	12 40	12 89	156 94	46 81	163 24	45
46	44 22	12 68	13 18	160 42	47 85	166 86	46
47	45 17	12 95	13 47	163 91	48 89	170 50	47
48	46 13	13 23	13 76	167 40	49 93	174 12	48
49	47 09	13 50	14 05	170 89	50 97	177 75	49
50	48 06	13 78	14 34	174 37	52 01	181 40	50

Numbers	Sines Degrees 16 N.pt.	Sines Degrees 74 N.pt.	Tangents Degrees 16 N.pt.	Tangents Degrees 74 N.pts.	Secants Degrees 16 N. pt.	Secants Degrees 74 N.pts.	Numbers
51	49 02	14 05	14 62	177 86	53 06	185 03	51
52	49 98	14 33	14 90	181 35	54 10	188 66	52
53	50 94	14 60	15 19	184 84	55 14	192 29	53
54	51 90	14 88	15 48	188 32	56 18	195 81	54
55	52 87	15 16	15 77	191 81	57 22	199 54	55
56	53 83	15 43	16 06	195 30	58 26	203 17	56
57	54 79	15 71	16 35	198 79	59 30	206 80	57
58	55 75	15 98	16 62	202 27	60 34	210 43	58
59	56 71	16 26	16 90	205 76	61 38	214 05	59
60	57 67	16 54	17 20	209 25	62 42	217 68	60
61	58 63	16 81	17 49	212 74	63 46	221 31	61
62	59 59	17 08	17 78	216 22	64 50	224 93	62
63	60 55	17 36	18 07	219 71	65 54	228 56	63
64	61 51	17 63	18 36	223 20	66 58	232 19	64
65	62 48	17 91	18 63	226 69	67 62	235 82	65
66	63 44	18 18	18 92	230 17	68 66	239 45	66
67	64 40	18 46	19 21	233 66	69 70	243 07	67
68	65 36	18 74	19 50	237 15	70 74	246 70	68
69	66 32	19 02	19 79	240 64	71 78	250 33	69
70	67 28	19 28	20 07	244 13	72 82	253 96	70
71	68 25	19 57	20 36	247 61	73 86	257 60	71
72	69 20	19 84	20 64	251 10	74 90	261 22	72
73	70 16	20 12	20 92	254 59	75 94	264 85	73
74	71 12	20 39	21 21	258 07	76 98	268 48	74
75	72 09	20 67	21 50	261 56	78 02	272 10	75
76	73 05	20 94	21 79	265 04	79 06	275 73	76
77	74 02	21 22	22 07	268 54	80 10	279 36	77
78	74 98	21 49	22 36	272 02	81 14	282 98	78
79	75 94	21 77	22 65	275 51	82 18	286 61	79
80	76 90	22 03	22 94	278 99	83 22	290 24	80
81	77 86	22 32	23 23	282 48	84 26	293 88	81
82	78 84	22 59	23 52	285 96	85 30	297 50	82
83	79 80	22 87	23 80	289 45	86 34	301 12	83
84	80 77	23 15	24 08	292 94	87 38	304 75	84
85	81 73	23 42	24 37	296 42	88 42	308 38	85
86	82 69	23 70	24 66	299 91	89 46	312 00	86
87	83 65	23 97	24 95	303 40	90 50	315 63	87
88	84 61	24 25	25 24	306 89	91 54	319 26	88
89	85 57	24 53	25 53	310 38	92 58	322 88	89
90	86 51	24 81	25 81	313 87	93 63	326 52	90
91	87 47	25 07	26 09	317 35	94 67	330 14	91
92	88 44	25 35	26 38	320 84	95 71	333 77	92
93	89 40	25 62	26 67	324 33	96 75	337 40	93
94	90 36	25 90	26 96	327 81	97 79	341 02	94
95	91 32	26 17	27 25	331 30	98 83	344 65	95
96	92 28	26 45	27 54	334 79	99 87	348 20	96
97	93 24	26 73	27 82	338 27	100 91	351 90	97
98	94 22	27 01	28 10	341 76	101 95	355 53	98
99	95 16	27 28	28 38	345 24	102 99	359 16	99
100	96 13	27 56	28 67	348 72	104 03	362 80	100

6 Rumb and an halfe is 73 deg. 7 min.

Numbers	Sines Degrees 17 N. pt	Sines Degrees 17 difference	Sines Degrees 73 N. pt	Sines Degrees 73 difference	Tangents Degrees 17 N. pt	Tangents Degrees 17 difference	Tangents Degrees 73 N. pts	Tangents Degrees 73 difference	Secants Degrees 17 N. pt.	Secants Degrees 17 difference	Secants Degrees 73 N pts.	Secants Degrees 73 difference	Numbers
1	00 96		00 29		00 31		03 27		01 05		03 41		1
2	01 91	95	00 88	59	00 61	30	06 54	3 27	02 09	4	06 84	43	2
3	02 87	96	00 88	0	00 92	31	09 81	3 27	03 14	5	10 26	42	3
4	03 83	96	01 17	29	01 22	30	13 08	3 27	04 18	4	13 68	42	4
5	04 78	95	01 46	29	01 53	31	16 35	3 27	05 23	5	17 10	42	5
6	05 74	96	01 75	29	01 83	30	19 63	3 28	06 27	4	20 52	42	6
7	06 69	95	02 05	30	02 14	31	22 90	3 27	07 32	5	23 94	42	7
8	07 65	96	02 34	29	02 45	31	26 17	3 27	08 37	5	27 36	42	8
9	08 61	96	02 63	29	02 75	30	29 44	3 27	09 41	4	30 78	42	9
10	09 56	95	02 92	29	03 06	31	32 71	3 27	10 46	5	34 20	42	10
11	10 52	96	03 21	29	03 30	24	35 98	3 27	11 50	4	37 62	42	11
12	11 48	96	03 51	30	03 67	37	39 25	3 27	12 55	5	41 04	42	12
13	12 43	95	04 80	29	03 97	30	42 53	3 28	13 59	4	44 46	42	13
14	13 39	96	04 09	29	04 28	31	45 80	3 27	14 64	5	47 88	42	14
15	14 34	95	04 38	29	04 58	30	49 07	3 27	15 68	4	51 30	42	15
16	15 30	96	04 66	28	04 89	31	52 34	3 27	16 73	5	54 72	42	16
17	16 26	96	04 97	31	05 20	31	55 61	3 27	17 77	4	58 14	42	17
18	17 21	95	05 26	29	05 50	30	58 88	3 27	18 82	5	61 56	42	18
19	18 17	96	05 55	29	05 81	31	62 15	3 27	19 87	5	64 98	42	19
20	19 12	95	05 85	30	06 11	30	65 42	3 27	20 91	4	68 41	43	20
21	20 08	96	06 14	29	06 42	31	68 69	3 27	21 96	5	71 83	42	21
22	21 04	96	06 43	29	06 72	30	71 98	3 29	23 00	4	75 25	42	22
23	21 99	95	06 72	29	07 03	31	75 24	3 26	24 05	5	78 67	42	23
24	22 95	96	07 02	30	07 33	30	78 51	3 27	25 09	4	82 09	42	24
25	23 91	96	07 31	29	07 64	31	81 78	3 27	26 14	5	85 51	42	25
26	24 86	95	07 60	29	07 95	31	85 05	3 27	27 18	4	88 93	42	26
27	25 82	96	07 89	29	08 25	30	88 32	3 27	28 23	5	92 35	42	27
28	26 78	96	08 18	29	08 56	31	91 60	3 28	29 27	4	95 77	42	28
29	27 73	95	08 48	30	08 86	30	94 87	3 27	30 32	5	99 19	42	29
30	28 69	96	08 77	29	09 17	31	98 13	3 26	31 37	5	102 61	42	30
31	29 64	95	09 06	29	09 47	30	101 41	3 28	32 41	4	105 03	42	31
32	30 60	96	09 35	29	09 78	31	104 68	3 27	33 46	5	109 45	42	32
33	31 56	96	09 65	30	10 08	30	107 95	3 27	34 50	5	112 86	41	33
34	32 51	95	09 94	29	10 39	31	111 22	3 27	35 55	5	116 28	42	34
35	33 47	96	10 23	29	10 70	31	114 50	3 28	36 59	4	119 71	43	35
36	34 42	95	10 52	29	11 00	30	117 77	3 27	37 64	5	123 13	42	36
37	35 38	96	10 81	29	11 31	31	121 03	3 26	38 68	4	126 55	42	37
38	36 34	96	11 11	30	11 62	31	124 31	3 28	39 73	5	129 98	43	38
39	37 29	95	11 40	29	11 92	30	127 58	3 27	40 78	5	133 39	41	39
40	38 25	96	11 69	29	12 23	31	130 83	3 25	41 83	5	136 81	42	40
41	39 21	96	11 99	30	12 53	30	134 11	3 28	42 87	4	140 23	42	41
42	40 16	95	12 28	29	12 84	31	137 38	3 27	43 91	4	143 65	42	42
43	41 12	96	12 57	29	13 15	31	140 66	3 28	44 96	5	147 08	43	43
44	42 08	96	12 86	29	13 45	30	143 93	3 27	46 00	4	150 49	41	44
45	43 03	95	13 15	29	13 76	31	147 20	3 27	47 05	5	153 91	42	45
46	43 99	96	13 45	30	14 07	31	150 47	3 27	48 10	5	157 33	42	46
47	44 94	95	13 74	29	14 37	30	153 74	3 27	49 15	5	160 75	42	47
48	45 90	96	14 03	29	14 68	31	157 00	3 26	50 19	4	164 18	43	48
49	46 86	96	14 32	29	14 98	30	160 27	3 27	51 24	5	167 59	41	49
50	47 81	95	14 62	30	15 29	31	163 54	3 27	52 28	4	171 01	42	50

1 Rumb and an halfe is 16 deg. 53 min.

Numbers	Sines Degrees 17 N.pt.	Sines Degrees 73 N.pt.	Tangents Degrees 17 N.pt.	Tangents Degrees 73 N.pts.	Secants Degrees 17 N. pt.	Secants Degrees 73 N.pts.	Numbers
51	48 77	14 91	15 59	166 81	53 33	174 44	51
52	49 73	15 20	15 90	170 08	54 38	177 86	52
53	50 68	15 50	16 21	173 35	55 42	181 28	53
54	51 64	15 79	16 51	176 63	56 47	184 70	54
55	52 59	16 08	16 81	179 90	57 51	188 12	55
56	53 55	16 37	17 12	183 18	58 56	191 54	56
57	54 51	16 67	17 42	186 44	59 60	194 96	57
58	55 46	16 96	17 73	189 71	60 65	198 38	58
59	56 42	17 25	18 03	192 98	61 69	201 80	59
60	57 38	17 54	18 34	196 25	62 74	205 22	60
61	58 33	17 84	18 64	199 53	63 78	208 64	61
62	59 29	18 13	18 95	202 80	64 83	212 06	62
63	60 24	18 42	19 25	206 07	65 88	215 48	63
64	61 20	18 71	19 56	209 34	66 92	218 90	64
65	62 16	19 00	19 86	212 61	67 97	222 32	65
66	63 11	19 29	20 17	215 88	69 01	225 74	66
67	64 07	19 58	20 47	219 15	70 06	229 16	67
68	65 02	19 88	20 78	222 42	71 10	232 58	68
69	65 98	20 17	21 09	225 70	72 15	236 00	69
70	66 94	20 47	21 40	228 98	73 20	239 42	70
71	67 89	20 76	21 71	232 25	74 24	242 84	71
72	68 85	21 05	22 01	235 52	75 29	246 26	72
73	69 81	21 34	22 32	238 79	76 33	249 68	73
74	70 76	21 63	22 62	242 06	77 38	253 10	74
75	71 72	21 92	22 93	245 32	78 42	256 52	75
76	72 68	22 21	23 23	248 59	79 47	259 94	76
77	73 63	22 50	23 54	251 86	80 51	263 36	77
78	74 59	22 80	23 84	255 13	81 56	266 78	78
79	75 54	23 09	24 15	258 40	82 60	270 20	79
80	76 50	23 39	24 46	261 67	83 66	273 62	80
81	77 46	23 68	24 76	264 94	84 70	277 04	81
82	78 41	23 97	25 07	268 21	85 75	280 46	82
83	79 37	24 26	25 37	271 48	86 79	283 88	83
84	80 32	24 55	25 68	274 76	87 84	287 30	84
85	81 28	24 85	25 98	278 03	88 89	290 72	85
86	82 24	25 14	26 29	281 31	89 93	294 14	86
87	83 19	25 43	26 59	284 58	90 98	297 56	87
88	84 15	25 72	26 90	287 86	92 02	300 98	88
89	85 11	26 02	27 21	291 14	93 07	304 41	89
90	86 07	26 31	27 52	294 38	94 11	307 83	90
91	87 02	26 60	27 82	297 65	95 16	311 25	91
92	87 98	26 90	28 13	300 92	96 20	314 67	92
93	88 93	27 19	28 43	304 21	97 25	318 09	93
94	89 89	27 48	28 74	307 46	98 29	321 51	94
95	90 84	27 77	29 04	310 73	99 34	324 93	95
96	91 80	28 06	29 35	314 00	100 39	328 35	96
97	92 76	28 36	29 65	317 27	101 43	331 77	97
98	93 71	28 65	29 96	320 54	102 48	335 19	98
99	94 67	28 94	30 26	323 81	103 52	338 61	99
100	95 63	29 24	30 57	327 09	104 57	342 03	100

1 Rumb and an halfe is 16 deg. 53 min.

Numbers	Sines Degrees 18 N.pt	Sines Degrees 72 N.pt	Tangents Degrees 18 N.pt.	Tangents Degrees 72 N.pts.	Secants Degrees 18 N. pt	Secants Degrees 72 N. pts.	Numbers
1	00 95	00 31	00 32	03 08	01 05	02 24	1
2	01 90	00 62	00 65	06 16	02 10	04 47	2
3	02 85	00 93	00 97	09 23	03 15	09 71	3
4	03 80	01 24	01 30	12 31	04 21	12 94	4
5	04 76	01 55	01 62	15 39	05 26	16 18	5
6	05 71	01 85	01 95	18 47	06 31	19 42	6
7	06 66	02 16	02 27	21 54	07 36	22 65	7
8	07 61	02 47	02 60	24 62	08 41	25 89	8
9	08 56	02 78	02 92	27 70	09 46	29 12	9
10	09 51	03 09	03 25	30 78	10 51	32 36	10
11	10 46	03 40	03 57	33 85	11 57	35 60	11
12	11 41	03 71	03 90	36 93	12 62	38 83	12
13	12 36	04 02	04 22	40 01	13 67	42 07	13
14	13 31	04 33	04 45	43 09	14 72	45 30	14
15	14 26	04 64	04 87	46 16	15 77	48 54	15
16	15 22	04 94	05 20	49 24	16 82	51 78	16
17	16 17	05 25	05 52	52 32	17 87	55 01	17
18	17 12	05 56	05 85	55 40	18 93	58 25	18
19	18 07	05 87	06 17	58 48	19 98	61 48	19
20	19 02	06 18	06 50	61 55	21 03	64 72	20
21	19 97	06 49	06 82	64 63	22 08	67 95	21
22	20 92	06 80	07 15	67 71	23 13	71 19	22
23	21 87	07 11	07 47	70 79	24 18	74 43	23
24	22 82	07 42	07 80	73 87	25 23	77 66	24
25	23 77	07 73	08 12	76 94	26 29	80 90	25
26	24 72	08 03	08 45	80 02	27 34	84 13	26
27	25 68	08 34	08 77	83 10	28 39	87 37	27
28	26 63	08 65	09 10	86 18	29 44	90 61	28
29	27 58	08 96	09 42	89 25	30 49	93 84	29
30	28 53	09 27	09 75	92 33	31 54	97 08	30
31	29 48	09 58	10 07	95 41	32 60	100 31	31
32	30 43	09 89	10 40	98 49	33 65	103 55	32
33	31 38	10 20	10 72	101 57	34 70	106 79	33
34	32 33	10 51	11 05	104 64	35 75	110 02	34
35	33 28	10 82	11 37	107 72	36 80	113 26	35
36	34 24	11 12	11 70	110 80	37 85	116 49	36
37	35 19	11 44	12 02	113 88	38 90	119 73	37
38	36 14	11 74	12 35	116 95	39 96	122 96	38
39	37 09	12 05	12 67	120 03	41 01	126 20	39
40	38 04	12 36	13 00	123 11	42 06	129 44	40
41	38 99	12 67	13 32	126 19	43 11	132 67	41
42	39 94	12 98	13 65	129 27	44 16	135 91	42
43	40 89	13 29	13 97	132 34	45 22	139 14	43
44	41 84	13 60	14 30	135 42	46 27	142 38	44
45	42 80	13 91	14 62	138 50	47 32	145 62	45
46	43 75	14 21	14 95	141 58	48 37	148 85	46
47	44 70	14 52	15 27	144 65	49 42	152 09	47
48	45 65	14 83	15 60	147 73	50 47	155 32	48
49	46 60	15 14	15 92	150 81	51 52	158 56	49
50	47 55	15 45	16 25	153 88	52 57	161 80	50

Numbers	Sines Degrees 18 N.pt.	Sines Degrees 72 N.pts.	Tangents Degrees 18 N.pt.	Tangents Degrees 72 N.pts.	Secants Degrees 18 N. pt.	Secants Degrees 72 N.pts.	Numbers
51	48 50	15 76	16 57	156 96	53 63	165 03	51
52	49 19 45	16 07	16 90	160 4 03	54 68	168 6 27	52
53	50 19 40	16 38	17 22	163 2 11	55 73	171 9 50	53
54	51 20 35	16 69	17 45	166 2 19	56 78	174 9 74	54
55	52 21	17 00	17 87	169 27	57 83	177 97	55
56	53 26	17 30	18 20	172 34	58 86	181 21	56
57	54 21	17 61	18 52	175 2 42	59 94	184 8 45	57
58	55 21 16	17 92	18 85	178 1 50	60 99	187 9 68	58
59	56 22 11	18 23	19 17	181 58	62 04	190 9 92	59
60	57 06	18 54	19 50	184 66	63 09	194 16	60
61	58 01	18 85	19 82	187 73	64 14	197 40	61
62	58 97	19 16	20 15	190 2 81	65 18	200 6 64	62
63	59 23 92	19 47	20 47	193 2 89	66 24	203 9 87	63
64	60 24 87	19 78	20 80	196 97	67 30	207 11 11	64
65	61 82	20 09	21 12	200 04	68 35	210 34	65
66	62 77	20 39	21 45	203 12	69 40	213 58	66
67	63 72	20 70	21 77	206 2 20	70 45	216 2 82	67
68	64 67	21 01	22 10	209 28	71 50	220 5 05	68
69	65 62	21 32	22 42	212 36	72 55	223 2 29	69
70	66 57	21 63	22 75	215 44	73 60	226 52	70
71	67 53	21 94	23 07	218 52	74 66	229 76	71
72	68 48	22 25	23 40	221 60	75 71	232 4 99	72
73	69 2 43	22 56	23 72	224 4 68	76 76	236 4 23	73
74	70 38	22 87	24 05	227 75	77 81	239 3 47	74
75	71 33	23 18	24 37	230 83	78 86	242 70	75
76	72 28	23 48	24 70	233 91	79 91	245 93	76
77	73 2 23	23 79	25 02	236 99	80 97	249 2 17	77
78	74 18	24 10	25 35	240 07	82 02	252 4 41	78
79	75 13	24 41	25 67	243 15	83 07	255 64	79
80	76 08	24 72	26 00	246 21	84 12	258 88	80
81	77 03	25 03	26 32	249 29	85 17	262 12	81
82	77 99	25 34	26 65	252 37	86 23	265 2 35	82
83	78 2 94	25 65	26 97	255 44	87 27	268 59	83
84	79 89	25 96	27 30	258 52	88 33	271 83	84
85	80 84	26 26	27 62	261 60	89 37	275 06	85
86	81 79	26 57	27 93	264 66	90 43	278 30	86
87	82 2 74	26 88	28 27	267 75	91 47	281 53	87
88	83 2 69	27 19	28 60	270 83	92 53	284 77	88
89	84 64	27 50	28 92	273 91	93 57	288 01	89
90	85 60	27 81	29 25	276 99	94 63	291 25	90
91	86 35	28 12	29 57	280 07	95 69	294 48	91
92	87 2 50	28 43	29 90	283 14	96 74	297 71	92
93	88 2 45	28 74	30 22	286 22	97 79	300 94	93
94	89 40	29 04	30 55	289 30	98 84	304 18	94
95	90 35	29 35	30 87	292 38	99 89	307 42	95
96	91 30	29 66	31 20	295 45	100 95	310 65	96
97	92 2 26	29 97	31 52	298 53	102 00	313 89	97
98	93 2 21	30 28	31 85	301 61	103 05	317 13	98
99	94 16	30 59	32 17	304 69	104 10	320 37	99
100	95 11	30 90	32 50	307 77	105 15	323 61	100

Numbers	Sines Degrees 19 N.pt	Sines Degrees 19 difference	Sines Degrees 71 N.pt	Sines Degrees 71 difference	Tangents Degrees 19 N.pt.	Tangents Degrees 19 difference	Tangents Degrees 71 N.pts.	Tangents Degrees 71 difference	Secants Degrees 19 N.pt	Secants Degrees 19 difference	Secants Degrees 71 N.pts.	Secants Degrees 71 difference	Numbers
1	00 95		00 33		00 34		02 90		01 06		03 07		1
2	01 89		00 65		00 69		05 81		02 11		06 14		2
3	02 84		00 98		01 03		08 71		03 17		09 21		3
4	03 78		01 30		01 38		11 62		04 23		12 29		4
5	04 73		01 63		01 72		14 52		05 29		15 36		5
6	05 67		01 95		02 07		17 43		06 35		18 43		6
7	06 62		02 28		02 41		20 33		07 40		21 50		7
8	07 56		02 60		02 75		23 23		08 46		24 57		8
9	08 51		02 93		03 10		26 14		09 52		27 64		9
10	09 46		03 26		03 44		29 04		10 58		30 72		10
11	10 40		03 58		03 79		31 95		11 63		33 79		11
12	11 35		03 91		04 13		34 85		12 69		36 86		12
13	12 30		04 23		04 48		37 76		13 75		39 93		13
14	13 24		04 56		04 82		40 66		14 81		43 00		14
15	14 18		04 88		05 16		43 57		15 86		46 07		15
16	15 13		05 21		05 51		46 47		16 92		49 14		16
17	16 07		05 53		05 85		49 37		17 98		52 21		17
18	17 02		05 86		06 20		52 28		19 04		55 29		18
19	17 96		06 19		06 54		55 18		20 09		58 36		19
20	18 91		06 51		06 89		58 08		21 15		61 43		20
21	19 86		06 84		07 23		60 99		22 21		64 50		21
22	20 80		07 17		07 58		63 89		23 27		67 57		22
23	21 75		07 49		07 92		66 80		24 33		70 64		23
24	22 69		07 82		08 27		69 70		25 38		73 72		24
25	23 64		08 15		08 61		72 61		26 44		76 79		25
26	24 58		08 47		08 95		75 51		27 50		79 86		26
27	25 53		08 80		09 30		78 42		28 56		82 93		27
28	26 47		09 13		09 64		81 32		29 61		86 00		28
29	27 42		09 45		09 99		84 22		30 67		89 07		29
30	28 37		09 77		10 33		89 13		31 73		92 15		30
31	29 31		10 10		10 68		90 03		32 79		95 21		31
32	30 26		10 42		11 02		92 94		33 84		98 29		32
33	31 20		10 75		11 36		95 84		34 90		101 36		33
34	32 15		11 08		11 71		98 74		35 96		104 43		34
35	33 09		11 40		12 05		101 65		37 02		107 50		35
36	34 04		11 73		12 40		104 55		38 07		110 57		36
37	34 98		12 06		12 74		107 46		39 13		113 64		37
38	35 93		12 38		13 09		110 36		40 19		116 72		38
39	36 87		12 71		13 43		113 27		41 25		119 79		39
40	37 82		13 02		13 77		116 17		42 30		122 86		40
41	38 87		13 35		14 12		119 07		43 36		155 93		41
42	39 72		13 67		14 47		121 98		44 42		129 00		42
43	40 66		14 00		14 81		124 88		45 48		132 07		43
44	41 61		14 33		15 15		127 79		46 54		135 15		44
45	42 56		14 65		15 50		130 69		47 59		138 22		45
46	43 50		14 98		15 84		133 59		48 65		141 30		46
47	44 45		15 30		16 19		136 50		49 71		144 37		47
48	45 39		15 63		16 55		139 40		50 77		147 44		48
49	46 34		15 95		16 88		142 30		51 82		150 51		49
50	47 28		16 28		17 22		145 21		52 88		153 58		50

Numbers	Sines Degrees 19 N.pt.	Sines Degrees 71 N.pt.	Tangents Degrees 19 N.pt.	Tangents Degrees 71 N.pts.	Secants Degrees 19 N. pt.	Secants Degrees 71 N.pts.	Numbers
51	48 23	16 60	17 56	148 11	53 94	156 63	51
52	49 17	16 09	17 91	151 02	55 00	159 73	52
53	50 12	17 58	18 25	153 92	56 06	162 80	53
54	51 06	17 58	18 60	156 83	57 11	165 87	54
55	52 01	17 91	18 94	159 73	58 17	168 94	55
56	52 95	18 23	19 29	162 63	59 23	172 01	56
57	53 89	18 56	19 63	165 54	60 29	175 08	57
58	54 84	18 88	19 97	168 44	61 35	178 15	58
59	55 78	19 21	20 32	171 35	62 40	181 22	59
60	56 73	19 53	20 66	174 25	63 46	184 29	60
61	57 67	19 86	21 00	177 16	64 52	187 36	61
62	58 62	20 19	21 34	180 06	65 58	190 43	62
63	59 56	20 51	21 69	182 97	67 63	193 50	63
64	60 51	20 84	22 03	185 87	67 69	196 57	64
65	61 46	21 17	22 38	188 77	68 75	199 64	65
66	62 40	21 49	22 72	191 68	69 81	202 72	66
67	63 35	21 82	23 07	194 58	70 86	205 79	67
68	64 30	22 15	23 41	197 49	71 92	208 86	68
69	65 24	22 47	23 75	200 39	72 98	211 93	69
70	66 19	22 79	24 10	203 29	74 03	215 01	70
71	67 13	23 13	24 44	206 20	75 09	218 08	71
72	68 07	23 45	24 79	209 11	76 15	221 15	72
73	69 02	23 77	25 13	212 01	77 21	224 22	73
74	69 96	24 10	25 48	214 92	78 27	227 30	74
75	70 91	24 42	25 82	217 82	79 33	230 37	75
76	71 86	24 75	26 16	220 72	80 38	233 44	76
77	72 80	25 08	26 51	223 63	81 44	236 51	77
78	73 75	25 40	26 85	226 53	82 50	239 58	78
79	74 69	25 73	27 20	229 44	83 56	242 65	79
80	75 64	26 05	27 55	232 34	84 61	245 72	80
81	76 58	26 38	27 89	235 25	85 67	248 79	81
82	77 53	26 71	28 23	238 15	86 73	251 86	82
83	78 47	27 02	28 58	241 05	87 79	254 93	83
84	79 42	27 35	28 92	243 96	88 84	258 00	84
85	80 37	27 67	29 27	246 86	89 90	261 07	85
86	81 31	28 00	29 61	249 77	90 96	264 14	86
87	82 26	28 33	29 95	252 67	92 02	267 21	87
88	83 20	28 65	30 30	255 57	93 07	270 29	88
89	84 15	28 98	30 64	258 48	94 13	273 36	89
90	85 10	29 30	30 99	261 38	95 19	276 44	90
91	86 04	29 63	31 33	264 29	96 25	279 51	91
92	86 98	29 95	31 68	267 19	97 30	282 58	92
93	87 93	30 28	32 02	270 10	98 36	285 65	93
94	88 87	30 60	32 36	273 00	99 42	288 73	94
95	89 82	30 93	32 71	275 91	100 48	291 80	95
96	90 87	31 26	33 05	278 81	101 54	294 87	96
97	91 76	31 58	33 40	281 71	102 59	297 94	97
98	92 66	31 91	33 74	284 62	103 65	301 01	98
99	93 61	32 23	34 09	287 52	104 71	304 08	99
100	94 55	32 56	34 43	290 42	105 76	307 16	100

Numbers	Secants Degrees 20 N. pt.	Secants Degrees 70 N. pts.	Numbers
1	01 06	02 92	1
2	02 13	05 85	2
3	03 19	08 77	3
4	04 26	11 70	4
5	05 32	14 62	5
6	06 39	17 54	6
7	07 45	20 47	7
8	08 51	23 39	8
9	09 58	26 31	9
10	10 64	29 24	10
11	11 70	32 16	11
12	12 77	35 09	12
13	13 83	38 01	13
14	14 90	40 93	14
15	15 96	43 86	15
16	17 03	46 78	16
17	18 09	49 70	17
18	19 15	52 63	18
19	20 22	55 55	19
20	21 28	58 48	20
21	22 35	61 40	21
22	23 41	64 32	22
23	24 48	67 25	23
24	25 54	70 17	24
25	26 60	73 10	25
26	27 67	76 02	26
27	28 73	78 94	27
28	29 80	81 87	28
29	30 86	84 79	29
30	31 93	87 71	30
31	32 99	90 64	31
32	34 05	93 56	32
33	35 12	96 49	33
34	36 18	99 41	34
35	37 25	102 33	35
36	38 31	105 26	36
37	39 38	108 18	37
38	40 44	111 11	38
39	41 50	114 03	39
40	42 57	116 95	40
41	43 63	119 88	41
42	44 69	122 80	42
43	45 76	125 72	43
44	46 82	128 65	44
45	47 89	131 57	45
46	48 95	134 50	46
47	50 02	137 42	47
48	51 08	140 34	48
49	52 14	143 27	49
50	53 21	146 18	50

Numbers	Tangents Degrees 20 N. pt	Tangents Degrees 70 N. pts	Numbers
1	00 36	02 75	1
2	00 73	05 49	2
3	01 09	08 24	3
4	01 46	10 99	4
5	01 82	13 74	5
6	02 18	16 48	6
7	02 55	19 23	7
8	02 91	21 98	8
9	03 28	24 73	9
10	03 64	27 47	10
11	04 00	30 22	11
12	04 37	32 97	12
13	04 73	35 72	13
14	05 10	38 46	14
15	05 46	41 21	15
16	05 82	43 95	16
17	06 19	46 70	17
18	06 55	49 45	18
19	06 92	52 21	19
20	07 28	54 95	20
21	07 64	57 70	21
22	08 01	60 44	22
23	08 37	63 20	23
24	08 74	65 94	24
25	09 10	68 69	25
26	09 47	71 43	26
27	09 82	74 19	27
28	10 19	76 93	28
29	10 56	79 68	29
30	10 92	82 42	30
31	11 29	85 18	31
32	11 65	87 92	32
33	12 01	90 67	33
34	12 37	93 41	34
35	12 74	96 17	35
36	13 10	98 91	36
37	13 47	101 66	37
38	13 82	104 40	38
39	14 19	107 16	39
40	14 56	109 90	40
41	14 93	112 65	41
42	15 29	115 39	42
43	15 65	118 15	43
44	16 02	120 86	44
45	16 38	123 64	45
46	16 75	126 38	46
47	17 11	129 14	47
48	17 48	131 88	48
49	17 83	134 63	49
50	18 20	137 37	50

Numbers	Sines Degrees 20 N. pt	Sines Degrees 70 N. pts	Numbers
1	00 94	00 34	1
2	01 88	00 68	2
3	02 82	01 03	3
4	03 76	01 37	4
5	04 70	01 71	5
6	05 64	02 05	6
7	06 58	02 40	7
8	07 52	02 74	8
9	08 46	03 08	9
10	09 40	03 42	10
11	10 34	03 76	11
12	11 28	04 10	12
13	12 22	04 45	13
14	13 16	04 79	14
15	14 10	05 13	15
16	15 04	05 47	16
17	15 98	05 82	17
18	16 92	06 16	18
19	17 86	06 50	19
20	18 79	06 84	20
21	19 73	07 18	21
22	20 67	07 52	22
23	21 61	07 87	23
24	22 55	08 21	24
25	23 49	08 55	25
26	24 43	08 89	26
27	25 37	09 24	27
28	26 31	09 58	28
29	27 25	09 92	29
30	28 19	10 26	30
31	29 13	10 60	31
32	30 07	10 94	32
33	31 01	11 28	33
34	31 95	11 62	34
35	32 89	11 97	35
36	33 83	12 31	36
37	34 77	12 65	37
38	35 71	13 00	38
39	36 65	13 34	39
40	37 59	13 68	40
41	38 53	14 03	41
42	39 47	14 37	42
43	40 41	14 71	43
44	41 35	15 05	44
45	42 29	15 40	45
46	43 23	15 74	46
47	44 17	16 08	47
48	45 11	16 42	48
49	46 05	16 76	49
50	46 99	17 10	50

6 Rumb and a quarter is 70 deg. 19 min.

Numbers	Sines Degrees 20 N.pt.	Sines Degrees 70 N.pt.	Tangents Degrees 20 N.pt.	Tangents Degrees 70 N.pts.	Secants Degrees 20 N. pt.	Secants Degrees 70 N.pts.	Numbers
51	47 92	17 45	18 56	140 13	54 27	149 11	51
52	48 86	17 079	18 193	142 087	55 33	152 404	52
53	49 032 80	18 013	19 029	145 362	56 040	154 896	53
54	50 074	18 047	19 066	148 836	57 347	157 789	54
55	51 68	18 82	20 02	151 12	58 53	160 82	55
56	52 62	19 16	20 38	153 86	59 59	163 73	56
57	53 56	19 050	20 175	156 61	60 066	166 866	57
58	54 350	19 084	21 111	159 409	61 072	169 558	58
59	55 44	20 18	21 48	162 911	62 79	172 851	59
60	56 38	20 52	21 84	164 85	63 85	175 43	60
61	57 32	20 87	22 22	167 60	64 92	178 35	61
62	58 26	21 21	22 157	170 34	65 098	181 128	62
63	59 320	21 055	22 593	173 807	67 04	184 319	63
64	60 014	21 89	23 30	175 984	68 411	187 612	64
65	61 08	22 24	23 66	178 59	69 17	190 05	65
66	62 02	22 58	24 02	181 33	70 24	192 97	66
67	62 1 96	22 192	24 139	184 509	71 030	195 90	67
68	63 047 90	23 126	24 575	186 683	72 037	198 082	68
69	64 84	23 60	25 12	189 1058	73 843	201 074	69
70	65 78	23 94	25 48	192 32	74 49	204 67	70
71	66 72	24 28	25 84	195 08	75 56	207 59	71
72	67 66	24 62	26 122	197 481	76 062	210 052	72
73	68 046 60	24 197	26 1 57	200 157	77 068	213 844	73
74	69 054	25 31	26 94	203 131	78 075	216 036	74
75	70 48	25 65	27 30	206 07	79 81	219 29	75
76	71 42	25 99	27 67	208 80	80 88	222 21	76
77	72 36	26 133	28 1 02	211 256	81 c 94	225 213	77
78	73 030	26 167	28 539	214 230	83 01	228 1506	78
79	74 024	27 02	28 76	217 106	84 07	234 198	79
80	75 18	27 36	29 12	219 79	85 13	233 90	80
81	76 12	27 70	29 49	222 55	86 20	236 82	81
82	77 06	28 104	29 85	225 029	87 026	2398 74	82
83	78 000	28 139	30 221	228 005	88 033	242 268	83
84	78 094	28 73	30 57	230 978	89 839	245 160	84
85	79 88	29 07	30 94	233 54	90 46	248 53	85
86	80 82	29 41	31 30	236 28	91 52	251 45	86
87	81 076	29 175	31 67	239 204	92 058	254 937	87
88	82 570	30 209	32 1 02	241 3777	93 065	257 230	88
89	83 064	30 244	32 39	244 53	94 71	262 22	89
90	84 57	30 78	32 76	247 27	95 78	263 14	90
91	85 51	31 12	33 13	250 03	96 84	266 07	91
92	86 045	31 146	33 1 49	252 1776	97 091	268 599	92
93	87 539	31 181	33 885	255 1452	98 097	271 291	93
94	88 033	32 15	34 22	258 1126	100 03	274 83	94
95	89 27	32 49	34 58	261 02	101 10	277 75	95
96	90 21	32 83	34 95	263 75	102 16	280 69	96
97	91 015	33 17	35 1 31	266 3551	103 023	283 661	97
98	92 509	33 551	35 568	269 1325	104 029	286 754	98
99	93 003	33 86	36 05	272 101	105 036	289 746	99
100	93 97	34 20	36 40	274 75	106 42	290 38	100

1 Rumb and three quarters is 19 deg. 41 min.

Numbers	Sines Degrees 21 N.pt	69 N.pt	Tangents Degrees 21 N.pt.	69 N.pts.	Secants Degrees 21 N. pt	69 N. pts.	Numbers
1	00 93	00 36	00 38	02 61	01 07	02 79	1
2	01 87	00 72	00 77	05 21	02 14	05 58	2
3	02 80	01 08	01 15	07 82	03 21	08 37	3
4	03 73	01 43	01 53	10 42	04 28	11 16	4
5	04 67	01 79	02 91	13 03	05 36	13 95	5
6	05 60	02 15	02 30	15 63	06 43	16 74	6
7	06 54	02 51	02 68	18 24	07 50	19 53	7
8	07 47	02 87	03 06	20 84	08 57	22 32	8
9	08 40	03 23	03 45	23 45	09 64	25 11	9
10	09 34	03 58	03 83	26 05	10 71	27 90	10
11	10 27	03 94	04 21	28 66	11 78	30 69	11
12	11 20	04 30	04 59	31 26	12 86	33 48	12
13	12 14	04 66	04 97	33 87	13 93	36 27	13
14	13 07	05 02	05 36	36 47	15 00	39 06	14
15	14 00	05 38	05 74	39 08	16 07	41 85	15
16	14 94	05 73	06 12	41 68	17 14	44 64	16
17	15 87	06 09	06 51	44 29	18 21	47 43	17
18	16 80	06 45	06 89	46 89	19 28	50 22	18
19	17 74	06 81	07 27	49 50	20 36	53 01	19
20	18 67	07 17	07 66	52 10	21 42	55 81	20
21	19 61	07 53	08 04	54 71	22 89	58 60	21
22	20 54	07 89	08 42	57 31	23 56	61 39	22
23	21 47	08 25	08 81	59 92	24 63	64 18	23
24	22 41	08 60	09 19	62 52	25 70	66 97	24
25	23 34	08 96	09 57	65 13	26 77	69 76	25
26	24 27	09 32	09 95	67 73	27 84	72 55	26
27	25 21	09 68	10 34	70 34	28 91	75 34	27
28	26 14	10 04	10 72	72 94	29 98	78 13	28
29	27 07	10 40	11 10	75 55	31 06	80 92	29
30	28 01	10 75	11 49	78 15	32 13	83 71	30
31	28 94	11 11	11 87	80 76	33 20	86 50	31
32	29 87	11 47	12 25	83 36	34 27	89 29	32
33	30 81	11 83	12 63	85 97	35 34	92 08	33
34	31 74	12 19	13 02	88 57	36 41	94 87	34
35	32 67	12 55	13 40	91 18	37 48	97 66	35
36	33 61	12 91	13 78	93 78	38 56	100 45	36
37	34 54	13 27	14 17	96 39	39 63	103 24	37
38	35 47	13 62	14 55	98 99	40 70	106 03	38
39	36 41	13 98	14 93	101 60	41 77	108 82	39
40	37 34	14 33	15 31	104 20	42 84	111 62	40
41	38 27	14 70	15 70	106 81	43 92	114 41	41
42	39 21	15 06	16 08	109 41	44 99	117 20	42
43	40 14	15 42	16 46	112 02	46 06	119 99	43
44	41 07	15 77	16 85	114 62	47 13	122 78	44
45	42 01	16 13	17 23	117 23	48 20	125 57	45
46	42 94	16 49	17 61	119 83	49 27	128 36	46
47	43 87	16 85	17 99	122 44	50 34	131 15	47
48	44 81	17 21	18 38	125 04	51 41	133 94	48
49	45 74	17 57	18 76	127 65	52 48	136 73	49
50	46 68	17 92	19 14	130 25	53 56	139 52	50

Numbers	Sines Degrees 21 N.pt.	Sines Degrees 69 N.pt.	Tangents Degrees 21 N.pts.	Tangents Degrees 69 N.pts.	Secants Degrees 21 N. pt.	Secants Degrees 69 N.pts.	Numbers
51	47 61	18 29	19 52	133 26	54 63	142 32	51
52	48 33 55	18 0 64	19 90	135 46	55 70	145 11	52
53	49 0 48	18 99	20 29	138 07	56 77	147 90	53
54	50 0 41	19 35	20 67	140 67	57 84	150 69	54
55	51 35	19 71	21 05	143 28	58 92	153 48	55
56	52 28	20 07	21 44	145 88	59 99	156 27	56
57	53 21	20 42	21 82	148 49	61 06	159 06	57
58	54 0 15	20 78	22 20	151 09	62 13	161 85	58
59	55 08	21 14	22 58	153 70	63 20	164 64	59
60	56 01	21 50	22 97	156 31	64 27	167 43	60
61	56 95	21 86	23 36	158 91	65 34	170 22	61
62	57 88	22 22	23 74	161 52	66 041	173 01	62
63	58 0 81	22 57	24 12	164 0 12	67 48	175 80	63
64	59 0 75	22 93	24 51	166 9 73	68 55	178 59	64
65	60 68	23 29	24 89	169 33	69 62	181 38	65
66	61 61	23 65	25 27	271 94	70 69	184 17	66
67	62 55	24 01	25 66	174 54	71 076	186 96	67
68	63 0 48	24 137	26 04	177 15	72 583	189 75	68
69	64 0 41	24 072	26 42	179 9 75	73 90	192 54	69
70	65 35	25 08	26 80	182 36	74 98	195 33	70
71	66 28	25 44	27 18	184 96	76 05	198 12	71
72	67 22	25 80	27 1 56	187 57	77 012	200 91	72
73	68 0 15	26 116	27 947	190 17	78 519	203 70	73
74	69 0 08	26 852	28 33	192 10 78	79 426	206 9 49	74
75	70 02	26 88	28 71	195 38	80 33	209 28	75
76	70 95	27 24	29 10	197 99	81 40	212 07	76
77	71 0 88	27 159	29 1 49	200 13 69	82 047	214 0 86	77
78	72 0 82	27 95	29 57 87	203 1 20	83 554	217 0 65	78
79	73 0 75	28 631	30 25	205 1 81	84 851	220 1 44	79
80	74 69	28 67	30 63	208 41	85 69	223 24	80
81	75 62	29 03	31 02	211 02	86 76	226 03	81
82	76 55	29 1 39	31 1 40	213 4 62	87 0 83	228 0 82	82
83	77 0 49	29 974	31 1 78	216 8 23	88 0 90	231 0 61	83
84	78 0 42	30 410	32 17	218 1 83	89 97	234 1 40	84
85	79 35	30 46	32 55	221 44	91 05	237 19	85
86	80 29	30 82	32 93	224 04	92 12	239 98	86
87	81 22	31 18	33 1 31	226 65	93 0 19	242 777	87
88	82 0 15	31 954	33 1 70	229 12 25	94 0 26	245 1 56	88
89	83 0 09	31 90	34 08	231 1 86	95 33	248 1 35	89
90	84 02	32 26	34 46	234 46	96 40	251 14	90
91	84 95	32 61	34 85	237 07	97 47	253 93	91
92	85 89	32 1 97	35 23	239 2 67	98 0 54	256 672	92
93	86 0 82	33 532	35 8 61	242 13 28	99 0 61	259 1 51	93
94	87 0 75	33 069	35 8 99	244 1 88	100 0 68	262 1 30	94
95	88 69	34 05	36 38	247 49	101 76	265 09	95
96	89 62	34 41	36 76	250 09	102 83	267 88	96
97	90 0 55	34 1 76	37 1 15	252 3 70	103 0 90	270 0 67	97
98	91 0 49	35 112	37 6 53	255 13 30	104 0 97	273 0 46	98
99	92 0 42	35 848	37 8 91	257 1 91	106 04	276 1 25	99
100	93 36	35 84	38 29	260 51	107 11	279 04	100

2 Rumb is 22 deg. 30 min.

Numbers	Sines Degrees 22 N.pt	Sines Degrees 22 difference	Sines Degrees 68 N.pt	Sines Degrees 68 difference	Tangents Degrees 22 N.pt.	Tangents Degrees 22 difference	Tangents Degrees 68 N.pts.	Tangents Degrees 68 difference	Secants Degrees 22 N.pt	Secants Degrees 22 difference	Secants Degrees 68 N.pts.	Secants Degrees 68 difference	Numbers
1	00 93	03	00 37	02	00 40	00	02 48	00	01 08	00	02 67	00	1
2	01 85	03	00 75	01	00 80	01	04 95	03	02 16	03	05 34	03	2
3	02 78	03	01 12	01	01 21	01	07 43	03	03 24	03	08 01	03	3
4	03 71	03	01 50	01	01 62	01	09 90	03	04 32	03	10 68	03	4
5	04 64	03	01 87	01	02 02	01	12 38	03	05 39	03	13 35	03	5
6	05 56	02	02 25	02	02 42	02	14 85	03	06 47	03	16 02	03	6
7	06 49	02	02 62	02	02 83	02	17 33	03	07 55	03	18 69	03	7
8	07 42	02	03 00	02	03 23	02	19 80	03	08 63	03	21 36	03	8
9	08 34	02	03 37	02	03 64	02	22 28	03	09 71	03	24 03	03	9
10	09 27	03	03 75	02	04 04	02	24 75	03	10 79	03	26 07	03	10
11	10 20	04	04 12	02	04 44	02	27 23	03	11 86	03	29 37	03	11
12	11 13	04	04 50	02	04 85	02	29 70	03	12 94	03	32 04	03	12
13	12 05	04	04 87	02	05 25	02	32 18	03	14 02	03	34 71	03	13
14	12 98	05	05 25	02	05 66	02	34 65	03	15 10	03	37 38	03	14
15	13 91	05	05 62	02	06 06	02	37 13	03	16 18	03	40 05	03	15
16	14 84	06	06 00	02	06 46	02	39 60	03	17 26	03	42 72	03	16
17	15 76	06	06 36	02	06 87	02	42 80	03	18 33	03	45 39	03	17
18	16 69	06	06 74	02	07 27	02	44 55	03	19 41	03	48 06	03	18
19	17 62	07	07 11	02	07 68	02	47 03	03	20 49	03	50 73	03	19
20	18 54	07	07 49	02	08 08	02	49 50	03	21 57	03	53 40	03	20
21	19 47	07	07 86	02	08 48	02	51 98	03	22 65	03	56 06	03	21
22	20 40	08	08 24	02	08 89	02	54 45	03	23 73	03	58 73	03	22
23	21 33	08	08 61	02	09 29	02	56 93	03	24 81	03	61 40	03	23
24	22 25	08	08 99	02	09 70	02	59 40	03	25 88	03	64 07	03	24
25	23 18	09	09 36	02	10 10	02	61 88	03	26 96	03	66 74	03	25
26	24 11	09	09 74	02	10 50	02	64 35	03	28 04	03	69 41	03	26
27	25 04	10	10 11	02	10 91	02	66 83	03	29 12	03	72 08	03	27
28	25 96	10	10 49	02	11 31	02	69 30	03	30 20	03	74 75	03	28
29	26 89	10	10 86	02	11 72	02	71 78	03	31 28	03	77 41	03	29
30	27 82	11	11 24	02	12 12	02	74 25	03	32 36	03	80 08	03	30
31	28 74	11	11 61	02	12 52	02	76 73	03	33 43	03	82 76	03	31
32	29 67	11	11 99	02	12 93	02	79 20	03	34 51	03	85 42	03	32
33	30 60	12	12 36	02	13 33	02	81 65	03	35 59	03	88 09	03	33
34	31 53	12	12 74	02	13 74	02	84 15	03	36 67	03	90 77	03	34
35	32 44	13	13 11	02	14 14	02	86 63	03	37 75	03	93 43	03	35
36	33 38	13	13 49	02	14 54	02	89 10	03	38 83	03	96 10	03	36
37	34 31	13	13 86	02	14 95	02	91 58	03	39 90	03	98 78	03	37
38	35 24	14	14 24	02	15 35	02	94 05	03	40 98	03	101 44	03	38
39	36 16	14	14 61	02	15 76	02	96 53	03	42 06	03	104 11	03	39
40	37 09	14	14 98	02	16 16	02	99 00	03	43 14	03	106 78	03	40
41	38 02	15	15 35	02	16 56	02	101 48	03	44 22	03	109 44	03	41
42	38 94	15	15 73	02	16 97	02	103 95	03	45 30	03	112 11	03	42
43	39 87	16	16 10	02	17 37	02	106 43	03	46 38	03	114 79	03	43
44	40 80	16	16 48	02	17 78	02	108 90	03	47 45	03	117 45	03	44
45	41 73	15	15 85	02	18 18	02	111 38	03	48 53	03	120 12	03	45
46	42 65	17	17 23	02	18 58	02	113 85	03	49 61	03	122 80	03	46
47	43 58	17	17 60	02	18 99	02	116 33	03	50 69	03	125 46	03	47
48	44 51	17	17 98	02	19 39	02	118 80	03	51 77	03	128 13	03	48
49	45 44	18	18 35	02	19 80	02	121 28	03	52 85	03	130 81	03	49
50	46 36	18	18 73	02	20 20	02	123 75	03	53 93	03	133 47	03	50

6 Rumb is 67 deg. 30 min.

Numbers	Sines Degrees 22 N.pt.	Sines Degrees 68 N.pt.	Tangents Degrees 22 N.pt.	Tangents Degrees 68 N.pts.	Secants Degrees 22 N. pt.	Secants Degrees 68 N.pts.	Numbers
51	47 28	19 10	20 60	126 23	55 00	136 14	51
52	48 21	19 40	21 01	128 70	56 08	138 82	52
53	49 14	19 85	21 41	131 89 18	57 16	141 48	53
54	50 06	20 23	21 82	133 65	58 24	144 15	54
55	50 99	20 60	22 22	136 13	59 31	146 83	55
56	51 92	20 98	22 62	138 60	60 39	149 49	56
57	52 84	21 35	23 03	141 08	61 47	152 16	57
58	53 77	21 73	23 43	143 55	62 55	154 84	58
59	54 70	22 10	23 84	146 03	63 63	157 50	59
60	55 63	22 48	24 24	148 51	64 71	160 17	60
61	56 55	22 85	24 64	150 99	65 79	162 85	61
62	57 48	23 23	25 05	153 46	66 86	165 51	62
63	58 41	23 60	25 45	155 94	67 94	168 18	63
64	59 34	23 98	25 86	158 41	69 02	170 86	64
65	60 26	24 35	26 26	160 89	70 10	173 52	65
66	61 19	24 73	26 66	162 36	71 18	176 18	66
67	62 12	25 10	27 07	165 84	72 26	178 86	67
68	63 04	25 48	27 47	168 31	73 33	181 52	68
69	63 97	25 85	27 88	170 79	74 41	184 18	69
70	64 90	26 22	28 28	173 26	75 50	186 86	70
71	65 83	26 59	28 68	175 74	76 57	189 52	71
72	66 75	26 97	29 09	178 21	77 65	192 19	72
73	67 68	27 34	29 49	180 68	78 73	194 87	73
74	68 61	27 72	30 90	183 16	79 81	197 53	74
75	69 54	28 09	30 30	185 64	80 88	200 20	75
76	70 46	28 47	30 71	188 11	81 96	202 88	76
77	71 39	28 84	31 11	190 59	83 04	205 54	77
78	72 32	29 21	31 51	193 06	84 12	208 21	78
79	73 24	29 59	31 92	195 54	85 20	210 89	79
80	74 17	29 97	32 22	198 01	86 28	213 56	80
81	75 10	30 34	32 72	200 49	87 36	216 22	81
82	76 03	30 72	33 13	202 96	88 43	218 90	82
83	76 95	31 09	33 53	205 44	89 51	221 56	83
84	77 88	31 47	33 94	207 91	90 59	224 23	84
85	78 81	31 84	34 34	210 39	91 67	226 91	85
86	79 74	32 21	34 74	212 86	92 75	229 57	86
87	80 66	32 59	35 15	215 34	93 83	232 24	87
88	81 59	32 97	35 55	217 81	94 90	234 92	88
89	82 52	33 34	35 96	220 29	96 98	237 58	89
90	83 45	33 71	36 36	222 76	97 07	240 25	90
91	84 38	34 08	36 76	225 24	98 14	242 93	91
92	85 31	34 46	37 17	227 71	99 22	245 59	92
93	86 24	34 83	37 57	230 19	100 30	248 26	93
94	87 16	35 20	37 98	232 66	101 38	250 94	94
95	88 09	35 58	38 38	235 14	102 45	253 60	95
96	89 02	35 95	38 78	237 61	103 53	256 27	96
97	89 94	36 33	39 19	239 99	104 61	258 95	97
98	90 87	36 70	39 59	242 56	105 69	261 61	98
99	91 80	37 08	40 00	245 04	106 77	264 28	99
100	92 72	37 46	40 40	247 51	107 85	266 95	100

6 Rumb is 67 deg. 30 min.

Numbers	Sines Degrees 23 N.pt	Sines Degrees 67 N.pt	Tangents Degrees 23 N. pt	Tangents Degrees 67 N. pts	Secants Degrees 23 N.pt.	Secants Degrees 67 N. pts.	Numbers
1	00 92	00 39	00 42	02 36	01 09	02 56	1
2	01 84	00 78	00 85	04 71	02 17	05 12	2
3	02 76	01 17	01 27	07 07	03 26	07 68	3
4	03 68	01 56	01 70	09 42	04 35	10 24	4
5	04 60	01 95	01 22	11 78	05 43	12 80	5
6	05 52	02 34	02 55	14 14	06 52	15 36	6
7	06 44	02 74	02 97	16 49	07 60	17 92	7
8	07 36	03 13	03 40	18 85	08 69	20 47	8
9	08 28	03 52	03 82	21 20	09 78	23 03	9
10	09 20	03 91	04 24	23 56	10 86	25 59	10
11	10 13	04 30	04 67	25 91	11 95	28 15	11
12	11 05	04 69	05 09	28 27	13 03	30 71	12
13	11 97	05 08	05 52	30 63	14 12	33 27	13
14	12 89	05 47	05 94	32 98	15 21	35 83	14
15	13 81	05 86	06 37	35 34	16 29	38 39	15
16	14 73	06 25	06 79	37 69	17 38	40 95	16
17	15 65	06 64	07 22	40 05	18 46	43 50	17
18	16 57	07 03	07 64	42 41	19 55	46 06	18
19	17 49	07 42	08 06	44 77	20 64	48 62	19
20	18 41	07 81	08 49	47 12	21 73	51 18	20
21	19 33	08 20	08 91	49 47	22 82	53 75	21
22	20 25	08 59	09 34	51 83	23 90	56 31	22
23	21 17	08 98	09 76	54 18	24 99	58 87	23
24	22 09	09 37	10 19	56 54	26 07	61 43	24
25	23 01	09 77	10 61	58 89	27 16	63 99	25
26	23 93	10 16	11 04	61 25	28 25	66 54	26
27	24 85	10 55	11 46	63 61	29 33	69 10	27
28	25 77	10 94	11 88	65 96	30 42	71 66	28
29	26 69	11 33	12 31	68 32	31 50	74 22	29
30	27 61	11 72	12 73	70 68	32 59	76 78	30
31	28 54	12 11	13 16	73 03	33 68	79 34	31
32	29 46	12 50	13 58	75 39	34 76	81 90	32
33	30 38	12 89	14 01	77 75	35 85	84 46	33
34	31 30	13 28	14 43	80 10	36 93	87 02	34
35	32 22	13 67	14 86	82 5	38 02	89 57	35
36	33 14	14 06	15 28	84 81	39 11	92 13	36
37	34 06	14 45	15 71	87 16	40 19	94 69	37
38	34 98	14 84	16 13	89 52	41 28	97 25	38
39	35 90	15 23	16 56	91 87	42 36	99 81	39
40	36 82	15 63	16 98	94 23	43 45	102 37	40
41	37 74	16 02	17 41	96 59	44 54	104 93	41
42	38 66	16 41	17 83	98 94	45 62	107 48	42
43	39 58	16 80	18 25	101 30	46 71	110 04	43
44	40 50	17 19	18 68	103 66	47 80	112 60	44
45	41 42	17 58	19 10	106 01	48 89	115 16	45
46	42 34	17 97	19 53	108 37	49 97	117 72	46
47	43 26	18 36	19 95	110 72	51 06	120 28	47
48	44 18	18 76	20 38	113 08	52 15	122 84	48
49	45 10	19 25	20 80	115 43	53 23	125 20	49
50	46 02	19 54	21 22	117 79	54 32	127 96	50

2 Rumb is 22 deg. 30 min.

Numbers	Sines Degrees 23 N.pt.	Sines Degrees 67 N.pt.	Tangents Degrees 23 N.pt.	Tangents Degrees 67 N.pts.	Secants Degrees 23 N. pt.	Secants Degrees 67 N.pts.	Numbers
51	46 95	19 93	21 65	120 15	55 40	130 51	51
52	47 87	20 32	22 107	122 50	56 49	133 07	52
53	48 79	20 71	22 150	124 85	57 58	135 63	53
54	49 71	21 10	22 92	127 21	58 66	138 19	54
55	50 63	21 49	23 35	129 57	59 75	140 76	55
56	51 55	21 88	23 77	131 92	60 83	143 32	56
57	52 47	22 27	24 120	134 28	61 92	145 88	57
58	53 39	22 66	24 162	136 64	63 01	148 44	58
59	54 31	23 05	25 05	138 99	64 09	151 00	59
60	55 23	23 44	25 47	141 32	65 18	153 56	60
61	56 15	23 83	25 89	143 70	66 26	156 12	61
62	57 07	24 22	26 132	146 06	67 35	158 68	62
63	57 99	24 61	26 174	148 42	68 44	161 24	63
64	58 91	25 01	27 17	150 78	69 53	163 80	64
65	59 83	25 40	27 59	153 13	70 62	166 36	65
66	60 75	25 79	28 02	155 48	71 70	168 92	66
67	61 67	26 18	28 144	157 84	72 79	171 47	67
68	62 59	26 57	28 187	160 19	73 87	174 03	68
69	63 51	26 96	29 29	162 55	74 96	176 59	69
70	64 43	27 35	29 71	164 91	76 05	179 15	70
71	65 36	27 74	30 14	167 27	77 14	181 71	71
72	66 28	28 13	30 77	169 63	78 22	184 27	72
73	67 20	28 52	30 99	171 98	79 31	186 83	73
74	68 12	28 91	31 41	174 34	80 39	189 39	74
75	69 04	29 31	31 44	176 70	81 48	191 95	75
76	69 96	29 70	32 26	179 05	82 57	194 50	76
77	70 88	30 09	32 69	181 41	83 65	197 06	77
78	71 80	30 48	33 111	183 77	84 74	199 62	78
79	72 72	30 87	33 54	186 12	85 82	202 18	79
80	73 64	31 26	33 96	188 47	86 91	204 74	80
81	74 56	31 65	34 39	190 83	88 00	207 31	81
82	75 48	32 04	34 81	193 18	89 09	209 87	82
83	76 40	32 43	35 123	195 54	90 17	212 43	83
84	77 32	32 82	35 166	197 89	91 26	214 99	84
85	78 24	33 21	36 08	200 25	92 35	217 54	85
86	79 16	33 60	36 51	202 61	93 43	220 10	86
87	80 08	33 99	36 93	204 96	94 52	222 66	87
88	81 00	34 38	37 136	207 32	95 60	225 22	88
89	81 92	34 77	37 78	209 68	96 69	227 78	89
90	82 84	35 17	38 20	212 03	97 77	230 34	90
91	83 77	35 56	38 63	214 39	98 86	232 90	91
92	84 69	35 95	39 105	216 74	99 95	235 46	92
93	85 61	36 34	39 148	219 10	101 03	238 02	93
94	86 53	36 73	39 90	221 45	102 12	241 57	94
95	87 45	37 12	40 32	223 81	103 21	243 13	95
96	88 37	37 51	40 75	226 17	104 29	245 69	96
97	89 29	37 90	41 118	228 52	105 37	248 25	97
98	90 21	38 29	41 160	230 88	106 46	250 81	98
99	91 13	38 68	42 03	233 23	107 55	253 37	99
100	92 05	39 07	42 45	235 58	108 64	255 93	10

2 Rumb is 22 deg. 30 min.

Numbers	Sines Degrees 24 N.pt	Sines Degrees 24 difference	Sines Degrees 66 N.pt	Sines Degrees 66 difference	Tangents Degrees 24 N. pt	Tangents Degrees 24 difference	Tangents Degrees 66 N. pts	Tangents Degrees 66 difference	Secants Degrees 24 N.pt.	Secants Degrees 24 difference	Secants Degrees 66 N. pts.	Secants Degrees 66 difference	Numbers
1	00 91	63	00 41	81	00 45	89	02 25	49	01 09	10	02 46	46	1
2	01 63	11	00 81	22	00 89	34	04 49	98	02 19	19	04 92	92	2
3	02 74	65	01 22	63	01 34	78	06 74	98	03 28	28	07 38	83	3
4	03 65	57	01 63	03	01 78	23	08 98	11	04 38	38	09 83	29	4
5	04 57		02 03		02 23		11 23		05 47		12 29		5
6	05 48	91	02 44	85	02 67	12	13 58	72	06 57	66	14 75	21	6
7	06 39	91	02 85	25	03 12	56	15 72	97	07 66	76	17 21	67	7
8	07 31	91	03 25	66	03 56	01	17 88	21	08 76	85	19 81	13	8
9	08 22	92	03 66	07	04 01	45	20 09	46	09 85	95	22 03	59	9
10	09 14	93	04 07	47	04 45	89	22 46	70	10 95	04	24 59	04	10
11	10 05	96	04 47	88	04 89	34	24 70	96	12 04	13	27 04	50	11
12	10 96	88	04 88	29	05 34	78	26 96	42	13 13	23	29 50	96	12
13	11 84	79	05 29	69	05 78	23	29 42	44	14 13	32	31 96	42	13
14	12 79	70	05 69	10	06 23	67	31 44	69	15 32	42	34 42	88	14
15	13 70	62	06 10	51	06 67	12	33 69	94	16 42	51	36 88	34	15
16	14 62	53	06 51	91	07 12	56	35 94	18	17 51	61	39 34	90	16
17	15 53	44	06 91	32	07 56	01	38 18	43	18 61	70	41 90	25	17
18	16 44	36	07 32	73	08 01	45	40 43	67	19 70	80	44 25	71	18
19	17 36	27	07 73	13	08 45	90	42 67	92	20 80	89	46 71	17	19
20	18 27	18	08 13	54	08 90	35	44 92	17	21 89	99	49 17	63	20
21	19 18	09	08 54	95	09 35	79	47 17	41	22 99	08	51 63	09	21
22	20 09	01	08 95	35	09 79	24	49 41	66	24 08	18	54 09	55	22
23	21 01	92	09 35	76	10 24	68	51 66	90	25 18	27	56 55	00	23
24	21 92	84	09 76	17	10 68	13	53 90	16	26 27	37	59 00	46	24
25	22 84	75	10 17	57	11 13	02	56 16	40	27 37	46	61 46	92	25
26	23 75	66	10 57	98	11 57	46	58 40	64	28 46	56	63 92	39	26
27	24 66	58	10 98	39	12 02	91	60 64	89	29 56	65	66 39	84	27
28	25 58	49	11 39	79	12 46	36	62 89	14	30 65	75	68 84	30	28
29	26 49	41	11 79	20	12 91	80	65 14	38	31 75	84	71 30	76	29
30	27 41	32	12 20	61	13 36	25	67 38	63	32 84	93	73 76	22	30
31	28 32	24	12 61	01	13 80	69	69 63	87	33 93	03	76 22	68	31
32	29 24	15	13 01	42	14 25	14	71 87	12	35 03	12	78 68	14	32
33	30 15	06	13 42	83	14 69	58	74 12	37	36 12	22	81 14	60	33
34	31 06	98	13 83	23	15 14	02	76 37	61	37 22	31	83 60	05	34
35	31 98	89	14 23	64	15 58	47	78 61	86	38 31	41	86 05	51	35
36	32 89	80	14 64	05	16 03	92	80 86	10	39 41	50	88 51	97	36
37	33 80	72	15 05	45	16 47	37	83 10	36	40 50	60	90 97	43	37
38	34 72	63	15 45	86	16 92	81	85 36	60	41 60	69	93 43	89	38
39	35 63	54	15 86	27	17 37	26	87 60	84	42 69	78	95 89	34	39
40	36 54	46	16 27	67	17 81	70	89 84	09	43 78	88	98 34	91	40
41	37 46	37	16 67	08	18 26	15	92 09	34	44 88	97	100 91	26	41
42	38 37	28	17 08	48	18 70	59	94 34	58	45 97	07	103 26	72	42
43	39 28	19	17 48	89	19 15	04	96 58	83	47 07	16	105 72	18	43
44	40 19	11	17 89	30	19 59	48	98 83	07	48 16	26	108 18	64	44
45	41 11	02	18 30	71	20 04	93	101 07	32	49 26	35	110 64	10	45
46	42 02	94	18 71	11	20 48	38	103 32	57	50 35	45	113 10	56	46
47	42 94	85	19 11	52	20 93	82	105 57	81	51 45	54	115 56	01	47
48	43 85	76	19 52	93	21 38	26	107 81	06	52 54	64	118 01	47	48
49	44 76	68	19 93	34	21 82		110 06		53 64	73	120 47	93	49
50	45 68		20 34		22 26		112 30		54 73		122 93		50

Numbers	Sines Degrees 24 N.pt.	Sines Degrees 66 N.pt.	Tangents Degrees 24 N.pt.	Tangents Degrees 66 N.pts.	Secants Degrees 24 N. pt.	Secants Degrees 66 N.pts.	Numbers
51	46 59	20 74	22 70	114 56	55 83	125 39	51
52	47 50	21 15	23 15	116 80	56 92	127 85	52
53	48 37	21 55	23 59	119 04	58 02	130 31	53
54	49 33	21 96	24 04	121 29	59 11	132 77	54
55	50 24	22 37	24 48	123 34	60 21	135 23	55
56	51 16	22 77	24 93	125 78	61 30	137 69	56
57	52 07	23 18	25 38	128 03	62 40	140 15	57
58	52 98	23 59	25 82	130 27	63 49	142 61	58
59	53 89	23 99	26 26	132 52	64 59	145 06	59
60	54 81	24 40	26 71	134 76	65 68	147 52	60
61	55 72	24 81	27 16	137 00	66 78	149 98	61
62	56 64	25 22	27 60	139 25	67 87	152 44	62
63	57 55	25 63	28 05	141 50	68 97	154 90	63
64	58 46	26 03	28 49	143 74	70 06	157 35	64
65	59 38	26 44	28 94	145 99	71 16	159 92	65
66	60 29	26 85	29 39	148 23	72 25	162 27	66
67	61 20	27 25	29 83	150 48	73 34	164 73	67
68	62 12	27 66	30 27	152 72	74 44	167 19	68
69	63 03	28 07	30 72	154 98	75 53	169 65	69
70	63 95	28 47	31 17	157 22	76 62	172 10	70
71	64 86	28 88	31 61	159 47	77 72	174 56	71
72	65 77	29 29	32 06	161 71	78 81	177 01	72
73	66 68	29 69	32 50	163 97	79 91	179 47	73
74	67 59	30 10	32 95	166 21	81 00	181 93	74
75	68 51	30 51	33 40	168 45	82 10	184 39	75
76	69 42	30 91	33 84	170 70	83 19	186 85	76
77	70 34	31 32	34 28	172 95	84 29	189 31	77
78	71 25	31 73	34 73	175 19	85 38	191 77	78
79	72 16	32 13	35 18	177 44	86 48	194 23	79
80	73 08	32 54	35 62	179 68	87 57	196 69	80
81	73 99	32 95	36 07	181 93	88 66	199 15	81
82	74 90	33 35	36 51	184 18	89 76	201 61	82
83	75 82	33 76	36 96	186 42	90 85	204 06	83
84	76 73	34 17	37 41	188 67	91 95	206 52	84
85	77 65	34 57	37 85	190 91	93 04	208 98	85
86	78 56	34 98	38 29	193 17	94 14	211 44	86
87	79 48	35 39	38 74	195 41	95 23	213 90	87
88	80 39	35 79	39 19	197 65	96 33	216 35	88
89	81 31	36 20	39 63	199 90	97 43	218 92	89
90	82 22	36 61	40 07	202 14	98 51	221 27	90
91	83 14	37 01	40 52	204 39	99 61	223 93	91
92	84 05	37 42	40 97	206 64	100 70	226 19	92
93	84 96	37 83	41 42	208 88	101 80	228 65	93
94	85 88	38 23	41 86	211 13	102 89	231 10	94
95	86 79	38 64	42 30	213 38	103 99	233 56	95
96	87 70	39 05	42 74	215 62	105 08	236 01	96
97	88 62	39 45	43 20	217 87	106 18	238 47	97
98	89 53	39 86	43 64	220 11	107 27	240 93	98
99	90 44	40 27	44 08	222 37	108 38	243 39	99
100	91 36	40 67	44 52	224 60	109 46	245 86	100

Numbers	Sines Degrees 25 N.pt	Sines Degrees 67 N.pt.	Tangents Degrees 25 N.pt.	Tangents Degrees 65 N.pts.	Secants Degrees 25 N. pt	Secants Degrees 65 N. pts.	Numbers
1	00 91	00 42	00 47	02 14	01 10	02 37	1
2	01 81	00 84	00 93	04 29	02 21	04 73	2
3	02 72	01 27	01 40	06 43	03 31	07 10	3
4	03 63	01 69	01 87	08 58	04 41	09 47	4
5	04 53	02 11	02 33	10 72	05 52	11 83	5
6	05 44	02 54	02 80	12 87	06 62	14 20	6
7	06 34	02 96	03 26	15 01	07 72	16 56	7
8	07 25	03 38	03 73	17 15	08 83	18 93	8
9	08 16	03 80	04 20	19 30	09 93	21 30	9
10	09 06	04 23	04 66	21 45	11 03	23 66	10
11	09 97	04 65	05 13	23 59	12 14	26 03	11
12	10 88	05 07	05 60	25 73	13 24	28 39	12
13	11 78	05 49	06 06	27 88	14 34	30 76	13
14	12 69	05 92	06 53	30 02	15 45	33 13	14
15	13 59	06 34	06 99	32 17	16 55	35 49	15
16	14 50	06 76	07 46	34 31	17 65	37 86	16
17	15 41	07 18	07 93	36 46	18 76	40 23	17
18	16 31	07 61	08 39	38 60	19 86	42 59	18
19	17 22	08 03	08 86	40 75	20 96	44 96	19
20	18 13	08 45	09 33	42 89	22 07	47 32	20
21	19 03	08 87	09 80	45 03	23 17	49 69	21
22	19 94	09 30	10 26	47 18	24 27	52 06	22
23	20 84	09 72	10 73	49 32	25 38	54 42	23
24	21 75	10 14	11 20	51 47	26 48	56 79	24
25	22 66	10 57	11 66	53 61	27 58	59 16	25
26	23 56	10 99	12 13	55 76	28 69	61 52	26
27	24 47	11 41	12 60	57 90	29 79	63 89	27
28	25 38	11 83	13 06	60 04	30 89	66 26	28
29	26 28	12 26	13 53	62 19	32 00	68 62	29
30	27 19	12 68	13 99	64 34	33 10	70 99	30
31	28 09	13 10	14 46	66 48	34 20	73 35	31
32	29 00	13 52	14 93	68 62	35 31	75 72	32
33	29 91	13 95	15 39	70 77	36 41	78 09	33
34	30 81	14 37	15 86	72 91	37 51	80 45	34
35	31 72	14 79	16 33	75 05	38 62	82 82	35
36	32 63	15 21	16 80	77 20	39 72	85 19	36
37	33 53	15 64	17 26	79 35	40 82	87 55	37
38	34 44	16 02	17 73	81 49	41 93	89 92	38
39	35 34	16 48	18 20	83 63	43 03	92 29	39
40	36 25	16 90	18 65	85 78	44 14	94 65	40
41	37 16	17 33	19 12	87 92	45 24	97 02	41
42	38 06	17 75	19 59	90 06	46 34	99 38	42
43	38 97	18 17	20 05	92 21	47 45	101 75	43
44	39 88	18 60	20 52	94 36	48 55	104 12	44
45	40 78	19 02	20 98	96 50	49 65	106 48	45
46	41 69	19 44	21 45	98 64	50 76	108 85	46
47	42 59	19 86	21 92	100 79	51 86	111 22	47
48	43 50	20 29	22 38	102 92	52 96	113 58	48
49	44 41	20 71	22 85	105 07	54 07	115 95	49
50	45 32	21 13	23 32	107 23	55 17	118 31	50

Numbers	Sines Degrees 25 N.pt.	Sines Degrees 65 N.pt.	Tangents Degrees 25 N.pt.	Tangents Degrees 65 N.pts.	Secants Degrees 25 N. pt.	Secants Degrees 65 N.pts.	Numbers
51	46 22	21 55	23 79	109 37	56 27	120 68	51
52	47 13	21 09	24 25	111 51	57 38	123 05	52
53	48 03	22 84	24 72	113 64	58 48	125 41	53
54	48 94	22 82	25 19	115 80	59 58	127 78	54
55	49 85	23 24	25 65	117 93	60 69	130 15	55
56	50 75	23 67	26 12	120 08	61 79	132 51	56
57	51 66	24 09	26 59	122 24	62 89	134 88	57
58	52 56	24 51	27 05	124 38	64 00	137 25	58
59	53 47	24 93	27 52	126 52	65 10	139 61	59
60	54 38	25 36	27 98	128 67	66 20	141 97	60
61	55 28	25 78	28 45	130 81	67 31	144 34	61
62	56 19	26 20	28 92	132 95	68 41	146 71	62
63	57 09	26 63	29 38	135 10	69 51	149 08	63
64	58 00	27 05	29 85	137 24	70 62	151 44	64
65	58 91	27 47	30 32	139 39	71 72	153 81	65
66	59 81	27 89	30 78	141 54	72 82	156 18	66
67	60 72	28 32	31 24	143 68	73 93	158 54	67
68	61 63	28 74	31 71	145 83	75 03	160 91	68
69	62 53	29 16	32 18	147 97	76 13	163 27	69
70	63 44	29 58	32 64	150 12	77 24	165 63	70
71	64 35	30 01	33 11	152 26	78 34	168 00	71
72	65 25	30 43	33 58	154 41	79 44	170 37	72
73	66 16	30 85	34 04	156 55	80 55	172 73	73
74	67 06	31 27	34 51	158 69	81 65	175 10	74
75	67 97	31 70	34 97	160 84	82 75	177 47	75
76	68 88	32 12	35 44	162 98	83 86	179 83	76
77	69 78	32 54	35 91	165 13	84 96	182 20	77
78	70 69	32 96	36 37	167 27	86 06	184 56	78
79	71 59	33 39	36 84	169 42	87 17	186 93	79
80	72 50	33 81	37 30	171 56	88 27	189 30	80
81	73 41	34 23	37 77	173 70	89 37	191 66	81
82	74 31	34 66	38 23	175 85	90 48	194 03	82
83	75 22	35 08	38 70	177 99	91 58	196 39	83
84	76 13	35 50	39 17	180 14	92 68	198 76	84
85	77 03	35 92	39 63	182 28	93 79	201 13	85
86	77 94	36 35	40 10	184 43	94 89	203 49	86
87	78 85	36 77	40 57	186 57	95 99	205 86	87
88	79 75	37 19	41 03	188 71	97 10	208 23	88
89	80 66	37 61	41 50	190 86	98 20	210 59	89
90	81 57	38 04	41 97	193 00	99 30	212 96	90
91	82 47	38 46	42 44	195 14	100 41	215 32	91
92	83 38	38 88	42 91	197 29	101 51	217 69	92
93	84 28	39 30	43 37	199 43	102 61	220 06	93
94	85 19	39 73	43 84	201 57	103 72	222 42	94
95	86 10	40 15	44 30	203 72	104 82	224 79	95
96	87 00	40 57	44 77	205 87	105 92	227 16	96
97	87 91	40 99	45 23	208 01	107 03	229 52	97
98	88 82	41 42	45 70	210 15	108 13	231 89	98
99	89 72	41 84	46 17	212 30	109 23	234 26	99
100	90 63	42 26	46 63	214 45	110 34	236 62	100

2 Rumb and a quarter is 25 deg. 19 min.

5 Rumb and three quarters is 64 deg. 41 min.

Numbers	Sines Degrees 26 N. pt	Sines Degrees 64 N. pt	Tangents Degrees 26 N. pt.	Tangents Degrees 64 N. pts.	Secants Degrees 26 N. pt	Secants Degrees 64 N. pts.	Numbers
1	00 90	00 44	00 49	02 05	01 11	01 28	1
2	01 80	00 88	00 98	04 10	02 23	04 56	2
3	02 70	01 32	01 46	06 15	03 34	06 84	3
4	03 60	01 75	01 95	08 20	04 45	09 12	4
5	04 49	02 19	02 44	10 25	05 56	11 41	5
6	05 39	02 63	02 93	12 30	06 68	13 69	6
7	06 29	03 07	03 41	14 35	07 79	15 97	7
8	07 19	03 51	03 90	16 40	08 90	18 25	8
9	08 09	03 95	04 39	18 45	10 01	20 53	9
10	08 98	04 38	04 88	20 50	11 13	22 81	10
11	09 89	04 82	05 36	22 55	12 24	25 09	11
12	10 79	05 26	05 85	24 60	13 35	27 37	12
13	11 68	05 70	06 34	26 65	14 46	29 65	13
14	12 58	06 14	06 83	28 70	15 58	31 94	14
15	13 48	06 58	07 31	30 75	16 69	34 22	15
16	14 38	07 01	07 80	32 80	17 80	36 50	16
17	15 28	07 45	08 29	34 85	18 91	38 78	17
18	16 18	07 89	08 78	36 90	20 03	41 06	18
19	17 08	08 33	09 26	38 95	21 14	43 34	19
20	17 98	08 77	09 75	41 00	22 25	45 62	20
21	18 87	09 20	10 24	43 06	23 36	47 91	21
22	19 77	09 94	10 73	45 11	24 48	50 19	22
23	20 67	10 06	11 21	47 16	25 59	52 47	23
24	21 57	10 52	11 70	49 21	26 70	54 75	24
25	22 47	10 96	12 19	51 26	27 81	57 03	25
26	23 37	11 39	12 68	53 31	28 93	59 31	26
27	24 27	11 83	13 16	55 36	30 04	61 59	27
28	25 17	12 27	13 65	57 41	31 15	63 88	28
29	26 06	12 71	14 14	59 46	32 26	66 16	29
30	26 96	13 15	14 63	61 51	33 38	68 44	30
31	27 86	13 59	15 11	63 56	34 49	70 72	31
32	28 76	14 02	15 60	65 61	35 60	73 00	32
33	29 65	14 46	16 09	67 66	36 71	75 28	33
34	30 56	14 90	16 58	69 71	37 83	77 56	34
35	31 46	15 34	17 06	71 76	38 94	79 84	35
36	32 36	15 78	17 55	73 81	40 05	82 12	36
37	33 25	16 21	18 04	75 86	41 16	84 41	37
38	34 15	16 65	18 53	77 91	42 28	86 69	38
39	35 05	17 09	19 02	79 96	43 39	88 97	39
40	35 95	17 53	19 51	82 01	44 50	91 25	40
41	36 85	17 97	20 00	84 06	45 61	93 53	41
42	37 75	18 40	20 49	86 11	46 73	95 81	42
43	38 65	18 84	20 98	88 16	47 84	98 09	43
44	39 55	19 28	21 46	90 21	48 95	100 37	44
45	40 45	19 72	21 95	92 26	50 06	102 65	45
46	41 34	20 16	22 44	94 31	51 18	104 94	46
47	42 24	20 60	22 93	96 36	52 29	107 22	47
48	43 14	21 04	23 41	98 41	53 40	109 50	48
49	44 04	21 48	23 90	100 46	54 51	111 78	49
50	44 94	21 92	24 39	102 52	55 63	114 06	50

Numbers	Sines Degrees 26 N.pt.	Sines Degrees 64 N.pts.	Tangents Degrees 26 N.pt.	Tangents Degrees 64 N.pts.	Secants Degrees 26 N. pt.	Secants Degrees 64 N.pts.	Numbers
51	45 84	22 35	24 88	104 57	56 74	116 34	51
52	46 74	22 79	25 36	106 62	57 85	118 62	52
53	47 64	23 22	25 85	108 67	58 96	120 91	53
54	48 54	23 66	26 34	110 72	60 08	123 19	54
55	49 45	24 10	27 83	112 77	61 19	125 47	55
56	50 33	24 54	27 31	114 82	62 30	127 75	56
57	51 23	24 98	27 80	116 87	63 41	130 03	57
58	52 13	25 42	28 29	118 92	64 53	132 31	58
59	53 03	25 86	28 78	120 97	65 64	134 58	59
60	53 93	26 30	29 26	123 02	66 76	136 87	60
61	54 83	26 74	29 75	125 07	67 87	139 16	61
62	55 73	27 17	30 34	127 12	68 98	141 44	62
63	56 62	27 61	30 73	129 17	70 09	143 72	63
64	57 52	28 05	31 21	131 22	71 20	145 99	64
65	58 42	28 49	31 70	133 27	72 32	148 27	65
66	59 32	28 93	32 19	135 32	73 43	150 55	66
67	60 22	29 36	32 68	137 37	74 54	152 83	67
68	61 12	29 80	33 16	139 42	75 66	155 11	68
69	62 02	30 24	33 65	141 47	76 77	157 40	69
70	62 92	30 69	34 14	143 52	77 88	159 68	70
71	63 81	31 12	34 63	145 57	78 99	161 96	71
72	64 71	31 56	35 11	147 62	80 10	164 24	72
73	65 61	32 00	35 60	149 67	81 22	166 52	73
74	66 51	32 44	36 09	151 72	82 33	168 80	74
75	67 41	32 88	36 58	153 77	83 44	171 08	75
76	68 31	33 32	37 06	155 82	84 56	173 36	76
77	69 21	33 75	37 55	157 87	85 67	175 64	77
78	70 11	34 19	38 04	159 92	86 78	177 93	78
79	71 01	34 63	38 53	161 97	87 89	180 21	79
80	71 90	35 07	39 02	164 02	89 01	182 49	80
81	72 80	35 51	39 51	166 08	90 12	184 77	81
82	73 70	35 95	40 00	168 13	91 23	187 05	82
83	74 60	36 38	40 49	170 18	92 35	189 33	83
84	75 50	36 82	40 98	172 23	93 46	191 61	84
85	76 40	37 26	41 46	174 28	94 57	193 90	85
86	77 30	37 70	41 95	176 33	95 63	196 18	86
87	78 20	38 14	42 44	178 38	96 79	198 46	87
88	79 10	38 58	42 93	180 43	97 91	200 74	88
89	79 99	39 01	43 41	182 48	99 02	203 02	89
90	80 89	39 45	43 90	184 52	101 13	205 31	90
91	81 79	39 80	44 39	186 58	101 25	207 58	91
92	82 69	40 33	44 88	188 63	102 36	209 87	92
93	83 59	40 77	45 36	190 68	103 47	212 15	93
94	84 49	41 20	45 85	192 73	104 58	214 43	94
95	85 39	41 64	46 34	194 78	105 69	216 71	95
96	86 29	42 68	46 83	196 83	106 81	219 99	96
97	87 18	42 52	47 31	198 88	107 92	222 27	97
98	88 08	42 96	47 80	200 93	109 03	224 55	98
99	88 98	43 39	48 29	202 98	110 15	226 84	99
100	89 88	43 84	48 77	205 03	111 26	228 12	100

Numbers	Sines Degrees 27 N. pt	difference	Sines Degrees 63 N. pt	Tangents Degrees 27 N. pt	difference	Tangents Degrees 63 N. pts	Secants Degrees 27 N. pt.	difference	Secants Degrees 63 N. pts.	Numbers
1	00 89	1	00 45	00 51	1	01 96	01 12	1	02 20	1
2	01 78	1	00 91	01 02	1	03 93	02 24	2	04 40	2
3	02 67	1	01 36	01 53	2	05 89	03 37	3	06 61	3
4	03 57	2	01 82	02 04	3	07 85	04 49	4	08 81	4
5	04 46	2	02 27	02 55	4	09 81	05 61	5	11 01	5
6	05 35	3	02 72	03 06	5	11 78	06 73	6	13 22	6
7	06 24	4	03 18	03 57	6	13 74	07 86	7	15 42	7
8	07 13	4	03 63	04 08	7	15 70	08 98	8	17 62	8
9	08 02	5	04 09	04 59	8	17 66	10 10	9	19 82	9
10	08 92	6	04 54	05 10	9	63	11 22	10	22 03	10
11	09 80	7	04 99	05 60	10	21 59	12 34	11	24 23	11
12	10 69	8	05 45	06 11	11	23 55	13 47	12	26 43	12
13	11 58	8	05 80	06 62	12	25 51	14 59	13	28 64	13
14	12 47	9	06 36	07 13	13	27 48	15 71	14	30 84	14
15	13 36	10	06 81	07 64	14	29 44	16 83	15	33 04	15
16	14 26	10	07 26	08 15	15	31 40	17 96	16	35 24	16
17	15 15	11	07 72	08 66	16	33 36	19 08	17	37 45	17
18	16 04	12	08 17	09 17	17	35 33	20 20	18	39 65	18
19	16 93	12	08 63	09 68	18	37 29	21 32	19	41 85	19
20	17 82	13	09 08	10 19	19	39 25	22 45	20	44 05	20
21	18 71	14	09 53	10 70	20	41 21	23 57	21	46 26	21
22	19 60	14	09 99	11 21	21	43 18	24 69	22	48 46	22
23	20 50	15	10 44	11 72	22	45 14	25 81	23	50 66	23
24	21 39	16	10 90	12 23	23	47 10	26 93	24	52 87	24
25	22 28	16	11 35	12 74	24	49 06	28 06	25	55 07	25
26	23 17	17	11 80	13 25	25	51 03	29 18	26	57 27	26
27	24 06	18	12 26	13 76	26	52 99	30 29	27	59 47	27
28	24 95	19	12 71	14 27	27	54 95	31 42	28	61 68	28
29	25 84	19	13 17	14 78	28	56 91	32 55	29	63 88	29
30	26 75	20	13 62	15 29	29	58 88	33 67	30	66 08	30
31	27 62	21	14 08	15 79	30	60 84	34 79	31	68 28	31
32	28 51	22	14 53	16 30	31	62 80	35 91	32	70 49	32
33	29 40	22	14 98	16 81	32	64 76	37 03	33	72 69	33
34	30 29	23	15 44	17 32	33	66 73	38 16	34	74 89	34
35	31 19	24	15 89	17 83	34	68 69	39 28	35	77 10	35
36	32 08	25	16 35	18 34	35	70 65	40 40	36	79 30	36
37	32 97	25	16 80	18 85	36	72 61	41 52	37	81 50	37
38	33 86	26	17 25	19 36	37	74 58	42 64	38	83 70	38
39	34 75	27	17 71	19 87	38	76 54	43 77	39	85 91	39
40	35 64	28	18 16	20 38	39	78 50	44 89	40	88 11	40
41	36 53	28	18 62	20 89	40	80 46	46 01	41	90 31	41
42	37 42	29	19 07	21 40	41	82 43	47 13	42	92 51	42
43	38 34	30	19 52	21 91	42	84 39	48 26	43	94 72	43
44	39 20	31	19 98	22 42	43	86 35	49 38	44	96 92	44
45	40 10	32	20 43	22 93	44	88 31	50 50	45	99 12	45
46	40 99	32	20 89	23 44	45	90 28	51 62	46	101 33	46
47	41 88	33	21 34	23 95	46	92 24	52 74	47	103 53	47
48	42 77	34	21 79	24 46	47	94 20	53 88	48	105 73	48
49	43 66	35	22 25	24 97	48	96 16	55 00	49	107 93	49
50	44 55	36	22 70	25 48	49	98 13	56 12	50	110 14	50

Numbers	Sines Degrees 27 N.pt.	Sines Degrees 63 N.pt.	Tangents Degrees 27 N.pt.	Tangents Degrees 63 N.pts.	Secants Degrees 27 N. pt.	Secants Degrees 63 N.pts.	Numbers
51	45 45	23 16	25 98	100 09	57 24	112 34	51
52	46 34	23 61	26 49	102 05	58 37	114 54	52
53	47 23	24 07	27 00	104 02	59 49	116 74	53
54	48 12	24 52	27 52	105 98	61 61	118 95	54
55	49 01	24 97	28 02	107 94	61 73	121 15	55
56	49 90	25 43	28 53	109 90	62 86	123 35	56
57	50 79	25 88	29 04	111 86	63 98	125 55	57
58	51 68	26 34	29 55	113 83	65 10	127 76	58
59	52 58	26 79	30 06	115 79	66 22	129 96	59
60	53 46	27 24	30 57	117 76	67 34	132 16	60
61	54 36	27 70	31 08	119 72	68 47	134 36	61
62	55 25	28 15	31 59	121 68	69 59	136 57	62
63	56 14	28 61	32 10	123 65	70 71	138 77	63
64	57 03	29 06	32 60	125 61	71 83	140 97	64
65	57 92	29 51	33 11	127 57	72 96	143 18	65
66	58 81	29 97	33 62	129 53	74 08	145 38	66
67	59 70	30 42	34 13	131 50	75 20	147 58	67
68	60 59	30 88	34 64	133 46	76 32	149 78	68
69	61 48	31 33	35 15	135 42	77 45	151 99	69
70	62 37	31 78	35 67	137 38	78 56	154 19	70
71	63 27	32 24	36 17	139 35	79 69	156 39	71
72	64 16	32 69	36 68	141 31	80 81	158 60	72
73	65 05	33 15	37 19	143 27	81 93	160 80	73
74	65 94	33 60	37 70	145 23	83 06	163 00	74
75	66 83	34 06	38 21	147 20	84 18	165 20	75
76	67 72	34 51	38 72	149 16	85 29	167 41	76
77	68 61	34 96	39 23	151 12	86 42	169 61	77
78	69 51	35 42	39 74	153 08	87 55	171 81	78
79	70 40	35 87	40 25	155 05	88 67	174 01	79
80	71 28	36 32	40 76	157 01	89 79	176 22	80
81	72 18	36 78	41 27	158 97	90 91	178 42	81
82	73 07	37 23	41 78	160 93	92 03	180 62	82
83	73 96	37 69	42 29	162 90	93 16	182 83	83
84	74 85	38 14	42 79	164 86	94 28	185 03	84
85	75 74	38 60	43 30	166 82	95 40	187 23	85
86	76 63	39 05	43 81	168 78	96 52	189 43	86
87	77 52	39 50	44 32	170 75	97 64	191 64	87
88	78 41	39 96	44 83	172 71	98 77	193 84	88
89	79 30	40 41	45 34	174 67	99 89	196 04	89
90	80 19	40 86	45 86	176 63	101 01	198 24	90
91	81 08	41 32	46 36	178 60	102 13	200 45	91
92	81 99	41 76	46 87	180 56	103 26	202 65	92
93	82 87	42 22	47 38	182 52	104 38	204 85	93
94	83 76	42 67	47 89	184 48	105 50	207 05	94
95	84 65	43 13	48 40	186 45	106 62	209 26	95
96	85 54	43 58	48 91	188 41	107 70	211 46	96
97	86 43	44 04	49 42	190 37	108 88	213 66	97
98	87 32	44 50	49 93	192 33	110 00	215 86	98
99	88 21	44 94	50 44	194 30	111 12	218 07	99
100	89 10	45 40	50 95	196 26	112 23	220 27	100

2 Rumb and an halfe is 28 deg. 8 min.

Numbers	Sines Degrees 28 N. pt		Sines Degrees 62 N. pt		Tangents Degrees 28 N. pt		Tangents Degrees 62 N. pts		Secants Degrees 28 N. pt.		Secants Degrees 62 N. pts.	
1	00	38	00	47	00	53	01	88	01	13	02	13
2	01	77	00	94	01	06	03	76	02	27	04	26
3	02	65	01	41	01	60	05	64	03	40	06	39
4	03	53	01	88	02	13	07	52	04	53	08	52
5	04	41	02	35	02	66	09	40	05	66	10	65
6	05	30	02	82	03	19	11	28	06	80	12	78
7	06	18	03	29	03	72	13	17	07	93	14	91
8	07	06	03	76	04	25	15	05	08	06	17	04
9	07	95	04	23	04	79	16	93	10	19	19	17
10	08	83	04	69	05	32	18	81	11	33	21	30
11	09	71	05	16	05	85	20	69	12	46	23	43
12	10	59	05	63	06	38	22	57	13	59	25	56
13	11	48	06	10	06	91	24	45	14	72	27	69
14	12	36	06	57	07	44	26	33	15	86	29	82
15	13	24	07	04	07	98	28	21	16	99	31	95
16	14	13	07	51	08	51	30	09	18	12	34	08
17	15	01	07	98	09	04	31	97	19	25	36	21
18	15	89	08	45	09	57	33	85	20	39	38	34
19	16	78	08	92	10	10	35	73	21	52	40	47
20	17	66	09	39	10	63	37	61	22	65	42	60
21	18	54	09	86	11	16	39	49	23	79	44	73
22	19	42	10	33	11	70	41	37	24	92	46	86
23	20	31	10	79	12	23	43	25	26	05	48	99
24	21	19	11	26	12	76	45	14	27	18	51	12
25	22	07	11	73	13	29	47	02	28	32	53	25
26	22	96	12	20	13	82	48	90	29	45	55	38
27	23	84	12	67	14	35	50	78	30	58	57	51
28	24	72	13	14	14	89	52	66	31	71	59	64
29	25	60	13	61	15	42	54	54	32	85	61	77
30	26	49	14	08	15	95	56	42	33	98	63	90
31	27	37	14	55	16	48	58	30	35	11	66	03
32	28	25	15	02	17	02	60	19	36	24	68	16
33	29	14	15	49	17	55	62	07	37	38	70	29
34	30	02	15	96	18	08	63	95	38	51	72	42
35	30	90	16	43	18	61	65	83	39	64	74	55
36	31	79	16	89	19	14	67	71	40	78	76	68
37	32	67	17	36	19	67	69	59	41	91	78	81
38	33	55	17	83	20	20	71	47	43	04	80	94
39	34	43	18	30	20	73	73	35	44	17	83	07
40	35	32	18	78	21	27	75	23	45	30	85	20
41	36	20	19	21	21	80	77	11	46	44	87	33
42	37	08	19	71	22	34	78	99	47	57	89	46
43	37	97	20	18	22	87	80	87	48	70	91	59
44	38	85	20	65	23	40	82	75	49	84	93	72
45	39	73	21	12	23	93	84	63	50	97	95	85
46	40	61	21	59	24	46	86	51	52	10	97	98
47	41	51	22	06	25	00	88	39	53	23	100	11
48	42	38	22	53	25	53	90	27	54	37	102	24
49	43	26	23	00	26	06	92	16	55	50	104	37
50	44	51	23	47	26	59	94	04	56	63	106	50

5 Rumb and an halfe is 61 deg. 52 min.

Numbers	Sines Degrees 28 N.pt.	Sines Degrees 62 N.pt.	Tangents Degrees 28 N.pt.	Tangents Degrees 62 N.pts.	Secants Degrees 28 N. pt.	Secants Degrees 62 N.pts.	Numbers
51	45 03	23 94	27 13	95 92	57 77	108 63	51
52	45 91	24 41	27 66	97 80	58 90	110 76	52
53	46 80	24 88	28 19	99 68	60 03	112 89	53
54	47 68	25 35	28 74	101 56	61 16	115 02	54
55	48 56	25 82	29 25	103 44	62 29	117 15	55
56	49 44	26 29	29 79	105 32	63 43	119 28	56
57	50 33	26 76	30 32	107 21	64 56	121 42	57
58	51 21	27 23	30 85	109 09	65 69	123 54	58
59	52 09	27 69	31 38	110 97	66 83	125 67	59
60	52 98	28 17	31 90	112 84	67 95	127 80	60
61	53 86	28 63	32 44	114 73	69 08	129 93	61
62	54 74	29 10	32 98	116 61	70 21	132 06	62
63	55 62	29 57	33 51	118 49	71 35	134 19	63
64	56 52	30 04	34 04	120 37	72 48	136 32	64
65	57 39	30 51	34 57	122 25	73 61	138 45	65
66	58 27	30 98	35 10	124 13	74 76	140 58	66
67	59 16	31 45	35 63	126 01	75 89	142 71	67
68	60 04	31 92	36 16	127 89	77 02	144 84	68
69	60 92	32 39	36 70	129 77	78 15	146 97	69
70	61 81	32 86	37 22	131 65	79 28	149 10	70
71	62 69	33 33	37 76	133 53	80 42	151 23	71
72	63 57	33 79	38 29	135 41	81 55	153 36	72
73	64 45	34 26	38 82	137 29	82 68	155 49	73
74	65 34	34 73	39 35	139 18	83 82	157 62	74
75	66 22	35 20	39 89	141 06	84 94	159 75	75
76	67 10	35 67	40 42	142 94	86 07	161 88	76
77	67 99	36 14	40 95	144 82	87 20	164 01	77
78	68 87	36 61	41 48	146 70	88 34	166 14	78
79	69 75	37 08	42 02	148 58	89 47	168 27	79
80	70 64	37 56	42 54	150 46	90 61	170 40	80
81	71 53	38 02	43 08	152 34	91 75	172 53	81
82	72 40	38 49	43 61	154 22	92 88	174 66	82
83	73 28	38 96	44 14	156 10	94 01	176 79	83
84	74 17	39 43	44 67	157 98	95 14	178 92	84
85	75 05	39 89	45 20	159 86	96 27	181 05	85
86	75 93	40 36	45 73	161 74	97 41	183 18	86
87	76 82	40 83	46 27	163 62	98 54	185 31	87
88	77 70	41 30	46 80	165 50	99 67	187 44	88
89	78 58	41 78	47 33	167 38	100 80	189 57	89
90	79 47	42 25	47 85	169 27	101 93	191 70	90
91	80 35	42 72	48 39	171 15	103 08	193 83	91
92	81 23	43 18	48 92	173 03	104 19	195 96	92
93	82 11	43 65	49 45	174 91	105 33	198 09	93
94	83 00	44 12	49 98	176 79	106 46	200 22	94
95	83 88	44 59	50 51	178 69	107 60	202 35	95
96	84 76	45 06	51 04	180 55	108 74	204 48	96
97	85 65	45 53	51 58	182 43	109 87	206 61	97
98	86 54	46 00	52 11	184 31	111 00	208 74	98
99	87 41	46 47	52 64	186 20	112 13	210 87	99
100	88 29	46 95	53 17	188 07	113 26	213 00	100

2 Rumb and an halfe is 28 deg. 8 min.

Numbers	Sines Degrees 29 N.pt	Sines Degrees 29 difference	Sines Degrees 61 N.pt	Sines Degrees 61 difference	Tangents. Degrees 29 N.pt.	Tangents. Degrees 29 difference	Tangents. Degrees 61 N.pts.	Tangents. Degrees 61 difference	Secants Degrees 29 N. pt	Secants Degrees 29 difference	Secants Degrees 61 N. pts.	Secants Degrees 61 difference	Numbers
1	00 87	87	00 48	48	00 55	55	01 80	80	01 14	14	02 06	06	1
2	01 75	88	00 97	49	01 11	56	03 61	81	02 29	15	04 13	07	2
3	02 62	87	01 45	48	01 66	55	05 41	80	03 43	14	06 19	06	3
4	03 50	88	01 94	49	02 22	56	07 22	81	04 57	14	08 25	06	4
5	04 37	87	02 42	48	02 77	55	09 02	80	05 72	15	10 31	06	5
6	05 25	88	02 91	49	03 33	56	10 82	80	06 86	14	12 38	07	6
7	06 12	87	03 39	48	03 88	55	12 63	81	08 00	14	14 44	06	7
8	07 00	88	03 88	49	04 43	55	14 43	80	09 15	15	16 50	06	8
9	07 87	87	04 36	48	04 99	56	16 24	81	10 29	14	18 56	06	9
10	08 75	88	04 85	49	05 54	55	18 04	80	11 43	14	20 63	07	10
11	09 62	87	05 33	48	06 19	55	19 84	80	12 57	14	22 69	06	11
12	10 50	88	05 82	49	06 65	56	21 65	81	13 72	15	24 75	06	12
13	11 37	87	06 30	48	07 21	56	23 45	80	14 86	14	26 81	06	13
14	12 25	88	06 79	49	07 76	55	25 26	81	16 00	14	28 88	07	14
15	13 12	87	07 27	48	08 31	55	27 06	80	17 15	15	30 94	06	15
16	14 00	88	07 75	48	08 87	56	28 86	80	18 29	14	33 00	06	16
17	14 87	87	08 24	49	09 42	55	30 67	81	19 43	14	35 06	06	17
18	15 74	87	08 73	49	09 98	56	32 47	80	20 57	14	37 13	07	18
19	16 61	87	09 21	48	10 53	55	34 28	81	21 72	15	39 19	06	19
20	17 49	88	09 70	49	11 09	56	36 08	80	22 87	15	41 25	06	20
21	18 36	87	10 18	48	11 64	55	37 89	81	24 01	14	43 31	06	21
22	19 24	88	10 67	49	12 20	56	39 69	80	25 15	14	45 38	07	22
23	20 11	87	11 15	48	12 75	55	41 49	80	26 30	15	47 44	06	23
24	20 99	88	11 64	49	13 31	56	43 30	81	27 44	14	49 50	06	24
25	21 86	87	12 12	48	13 86	55	45 10	80	28 58	14	51 56	06	25
26	22 74	88	12 61	49	14 42	56	46 91	81	29 73	15	53 63	07	26
27	23 61	87	13 09	48	14 97	55	48 71	80	30 87	14	55 69	06	27
28	24 49	88	13 57	48	15 52	55	50 51	80	32 01	14	57 75	06	28
29	25 36	87	14 06	49	16 08	56	52 32	81	33 15	14	59 81	06	29
30	26 24	88	14 54	48	16 63	55	54 12	80	34 30	15	61 88	07	30
31	27 11	87	15 03	49	17 18	55	55 92	80	35 44	14	63 94	06	31
32	27 99	88	15 51	48	17 74	56	57 73	81	36 58	14	66 00	06	32
33	28 86	87	16 00	49	18 29	55	59 53	80	37 73	15	68 07	07	33
34	29 74	88	16 48	48	18 85	56	61 33	80	38 87	14	70 13	06	34
35	30 61	87	16 97	49	19 40	55	63 14	81	40 01	14	72 19	06	35
36	31 49	88	17 45	48	19 96	56	64 94	80	41 15	14	74 25	06	36
37	32 36	87	17 94	49	20 51	55	66 75	81	42 30	15	76 32	07	37
38	33 24	88	18 42	48	21 06	55	68 55	80	43 44	14	78 38	06	38
39	34 11	87	18 91	49	21 62	56	70 35	80	44 58	14	80 44	06	39
40	34 98	87	19 39	48	22 17	55	72 16	81	45 73	15	82 51	07	40
41	35 85	87	19 88	49	22 73	56	73 96	80	46 88	15	84 57	06	41
42	36 73	88	20 36	48	23 28	55	75 77	81	48 02	14	86 63	06	42
43	37 60	87	20 85	49	23 84	56	77 57	80	49 16	14	88 69	06	43
44	38 48	88	21 33	48	24 39	55	79 38	81	50 31	15	90 75	06	44
45	39 35	87	21 82	49	24 95	56	81 18	80	51 45	14	92 81	06	45
46	40 23	88	22 30	48	25 50	55	82 99	81	52 59	14	94 86	05	46
47	41 10	87	22 79	49	26 06	56	84 79	80	53 74	15	96 94	08	47
48	41 97	87	23 27	48	26 61	55	86 60	81	54 88	14	99 00	06	48
49	42 85	88	23 75	48	27 17	56	88 40	80	56 02	14	101 07	07	49
50	43 73	88	24 24	49	27 72	55	90 20	80	57 17	15	103 13	06	50

Numbers	Sines Degrees 29 N.pt.	Sines Degrees 61 N.pt.	Tangents Degrees 29 N.pt.	Tangents Degrees 61 N.pts.	Secants Degrees 29 N. pt.	Secants Degrees 61 N.pts.	Numbers
51	44 60	24 73	28 27	92 01	58 32	105 20	51
52	45 48	25 21	28 81	93 36	59 46	107 26	52
53	46 35	25 70	29 38	95 06	60 69	109 32	53
54	47 23	26 18	29 93	97 42	61 75	111 39	54
55	48 10	26 67	30 49	99 22	62 89	113 45	55
56	48 98	27 15	31 04	101 03	64 03	115 51	56
57	49 85	27 64	31 60	102 83	65 17	117 57	57
58	50 73	28 12	32 15	104 64	66 32	119 64	58
59	51 60	28 61	32 71	106 44	67 46	121 70	59
60	52 48	29 09	33 26	108 24	68 60	123 76	60
61	53 35	29 57	33 82	110 05	69 75	125 82	61
62	54 23	30 06	34 37	111 85	70 89	127 89	62
63	55 10	30 54	34 93	113 66	72 03	129 95	63
64	55 98	31 03	35 48	115 46	73 17	132 01	64
65	56 84	31 51	36 04	117 26	74 32	134 07	65
66	57 72	32 00	36 59	119 07	75 46	136 14	66
67	58 59	32 48	37 15	120 87	76 60	138 20	67
68	59 47	32 97	37 70	122 68	77 75	140 26	68
69	60 34	33 45	38 25	124 48	78 89	142 32	69
70	61 22	33 94	38 80	126 28	80 03	144 39	70
71	62 09	34 42	39 36	128 09	81 18	146 45	71
72	62 97	34 91	39 91	129 89	82 33	148 51	72
73	63 84	35 39	40 47	131 70	83 47	150 57	73
74	64 71	35 88	41 02	133 50	84 61	152 64	74
75	65 58	36 36	41 58	135 30	85 76	154 70	75
76	66 46	36 85	42 13	137 11	86 90	156 76	76
77	67 33	37 33	42 69	138 91	88 04	158 82	77
78	68 21	37 82	43 24	140 72	89 18	160 89	78
79	69 09	38 30	43 79	142 52	90 33	162 95	79
80	69 97	38 78	44 34	144 30	91 47	165 01	80
81	70 84	39 27	44 90	146 13	92 61	167 07	81
82	71 72	39 75	45 45	147 93	93 76	169 14	82
83	72 60	40 24	46 01	149 74	94 90	171 20	83
84	73 47	40 73	46 56	151 54	96 04	173 26	84
85	74 35	41 21	47 12	153 34	97 18	175 32	85
86	75 22	41 70	47 67	155 15	98 32	177 39	86
87	76 10	42 18	48 23	156 95	99 47	179 45	87
88	76 97	42 67	48 78	158 76	100 61	181 51	88
89	77 85	43 15	49 34	160 56	101 76	183 57	89
90	78 72	43 63	49 89	162 36	102 90	185 64	90
91	79 60	44 12	50 45	164 17	104 04	187 70	91
92	80 47	44 61	51 00	165 97	105 18	189 76	92
93	81 35	45 09	51 55	167 78	106 33	191 82	93
94	82 22	45 57	52 11	169 58	107 47	193 89	94
95	83 10	46 06	52 66	171 38	108 61	195 95	95
96	83 97	46 54	53 22	173 19	109 76	198 01	96
97	84 85	47 03	53 77	174 99	110 90	200 07	97
98	85 72	47 51	54 33	176 80	112 05	202 14	98
99	86 60	48 00	54 88	178 60	113 19	204 21	99
100	87 46	48 48	55 43	180 40	114 34	206 27	100

Numbers	Sines Degrees				Tangents Degrees				Secants Degrees				Numbers
	30		60		30		60		30		60		
	N. pt		N. pt		N. pt.		N. pts.		N. pt		N. pts.		
1	00	87	00	50	00	58	01	73	01	15	02	00	1
2	01	73	01	00	01	15	03	46	02	31	04	00	2
3	02	60	01	50	01	73	05	20	03	46	06	00	3
4	03	46	02	00	02	31	06	93	04	62	08	00	4
5	04	33	02	50	02	89	08	66	05	77	10	00	5
6	05	20	03	00	03	46	10	39	06	93	12	00	6
7	06	06	03	50	04	04	12	12	08	08	14	00	7
8	06	93	04	00	04	62	13	86	09	24	16	00	8
9	07	79	04	50	05	20	15	59	10	39	18	00	9
10	08	66	05	00	05	77	17	32	11	55	20	00	10
11	09	53	05	50	06	35	19	05	12	70	22	00	11
12	10	39	06	00	06	93	20	78	13	86	24	00	12
13	11	26	06	50	07	51	22	52	15	01	26	00	13
14	12	12	07	00	08	08	24	25	16	16	28	00	14
15	12	99	07	50	08	66	25	98	17	32	30	00	15
16	13	86	08	00	09	24	27	71	18	48	32	00	16
17	14	72	08	50	09	81	29	44	19	63	34	00	17
18	15	59	09	00	10	39	31	18	20	78	36	00	18
19	16	45	09	50	10	97	32	91	21	94	38	00	19
20	17	32	10	00	11	55	34	64	23	09	40	00	20
21	18	19	10	50	12	12	36	37	24	25	42	00	21
22	19	05	11	00	12	70	38	10	25	40	44	00	22
23	19	92	11	50	13	28	39	84	26	56	46	00	23
24	20	78	12	00	13	85	41	57	27	71	48	00	24
25	21	65	12	50	14	43	43	30	28	87	50	00	25
26	22	52	13	00	15	01	45	03	30	02	52	00	26
27	23	38	13	50	15	59	46	76	31	17	54	00	27
28	24	24	14	00	16	16	48	50	32	33	56	00	28
29	25	11	14	50	16	74	50	23	33	49	58	00	29
30	25	98	15	00	17	32	51	96	34	64	60	00	30
31	26	85	15	50	17	90	53	69	35	79	62	00	31
32	27	71	16	00	18	47	55	42	36	95	64	00	32
33	28	58	16	50	19	05	57	16	38	10	66	00	33
34	29	44	17	00	19	63	58	89	39	26	68	00	34
35	30	31	17	50	20	21	60	62	40	41	70	00	35
36	31	18	18	00	20	78	62	35	41	57	72	00	36
37	32	04	18	50	21	36	64	08	42	72	74	00	37
38	32	91	19	00	21	94	65	82	43	88	76	00	38
39	33	77	19	50	22	52	67	55	45	03	78	00	39
40	34	64	20	00	23	09	69	28	46	19	80	00	40
41	35	51	20	50	23	67	71	01	47	34	82	00	41
42	36	37	21	00	24	25	72	74	48	50	84	00	42
43	37	24	21	50	24	82	74	47	49	65	86	00	43
44	38	10	22	00	25	40	76	21	50	80	88	00	44
45	38	97	22	50	25	98	77	94	51	96	90	00	45
46	39	84	23	00	26	56	79	67	53	11	92	00	46
47	40	70	23	50	27	13	81	40	54	27	94	00	47
48	41	57	24	00	27	71	83	13	55	42	96	00	48
49	42	43	24	50	28	29	84	87	56	58	98	00	49
50	43	30	25	00	28	87	86	60	57	73	100	00	50

Numbers	Sines Degrees 30 N. pt.	Sines Degrees 60 N. pt.	Tangents Degrees 30 N. pt.	Tangents Degrees 60 N. pts.	Secants Degrees 30 N. pt.	Secants Degrees 60 N. pts.	Numbers
51	44 17	25 50	29 44	88 33	58 89	102 00	51
52	45 03	26 00	30 02	90 00	60 04	104 00	52
53	45 49	26 50	30 60	91 79	61 20	106 00	53
54	46 76	27 00	31 18	93 53	62 35	108 00	54
55	47 63	27 50	31 75	95 26	63 51	110 00	55
56	48 50	28 00	32 33	96 99	64 66	112 00	56
57	49 36	28 50	32 91	98 72	65 81	114 00	57
58	50 23	29 00	33 48	100 45	66 97	116 00	58
59	51 09	29 50	34 06	102 19	68 13	118 00	59
60	51 96	30 00	34 64	103 92	69 29	120 00	60
61	52 83	30 50	35 22	105 65	70 44	122 00	61
62	53 69	31 00	35 79	107 38	71 60	124 00	62
63	54 56	31 50	36 37	109 11	72 75	126 00	63
64	55 42	32 00	36 95	110 85	73 81	128 00	64
65	56 29	32 50	37 53	112 58	75 06	130 00	65
66	57 16	33 00	38 10	114 31	76 21	132 00	66
67	58 02	33 50	38 68	116 04	77 36	134 00	67
68	58 89	34 00	39 26	117 77	78 52	136 00	68
69	59 75	34 50	39 83	119 51	79 68	138 00	69
70	60 62	35 00	40 41	121 24	80 83	140 00	70
71	61 49	35 50	40 99	122 97	81 99	142 00	71
72	62 35	36 00	41 57	124 70	83 14	144 00	72
73	63 22	36 50	42 14	126 43	84 29	146 00	73
74	64 08	37 00	42 72	128 17	85 44	148 00	74
75	64 95	37 50	43 30	129 90	86 60	150 00	75
76	65 82	38 00	43 87	131 63	87 75	152 00	76
77	66 68	38 50	44 45	133 36	88 91	154 00	77
78	67 55	39 00	45 03	135 09	90 06	156 00	78
79	68 41	39 50	45 61	136 83	91 22	158 00	79
80	69 28	40 00	46 19	138 57	92 38	160 00	80
81	70 15	40 50	46 76	140 29	93 53	162 00	81
82	70 91	41 00	47 34	142 02	94 68	164 00	82
83	71 88	41 50	47 92	143 75	95 84	166 00	83
84	72 74	42 00	48 49	145 48	96 99	168 00	84
85	73 61	42 50	49 07	147 22	98 14	170 00	85
86	74 48	43 00	49 65	148 95	99 30	172 00	86
87	75 34	43 50	50 13	150 60	100 46	174 00	87
88	76 21	44 00	50 82	152 41	101 61	176 00	88
89	77 07	44 50	51 38	153 14	102 76	178 00	89
90	77 94	45 00	51 96	155 88	103 92	180 00	90
91	78 81	45 50	52 54	157 61	105 07	182 00	91
92	79 67	46 00	53 11	159 34	106 23	184 00	92
93	80 54	46 50	53 69	161 07	107 38	186 00	93
94	81 40	47 00	54 27	162 80	108 54	188 00	94
95	82 27	47 50	54 84	164 54	109 69	190 00	95
96	83 14	48 00	55 42	166 27	110 85	192 00	96
97	84 00	48 50	56 00	168 00	112 00	194 00	97
98	84 87	49 00	56 58	169 73	113 15	196 00	98
99	85 74	49 50	57 16	171 46	114 31	198 00	99
100	86 60	50 00	57 74	173 20	115 47	200 00	100

5 Rumb and a quarter is 59 deg. 4 min.

Numbers	Sines Degrees 31 N. pt	Sines Degrees 59 N. pt	Tangents Degrees 31 N. pt	Tangents Degrees 59 N. pts	Secants Degrees 31 N. pt.	Secants Degrees 59 N. pts.	Numbers
1	00 86	00 51	00 60	01 66	01 17	01 94	1
2	01 71	01 03	01 20	03 33	02 33	03 88	2
3	02 57	01 55	01 80	05 00	03 50	05 82	3
4	03 43	02 06	02 40	06 66	04 67	07 77	4
5	04 29	02 58	03 00	08 32	05 83	09 71	5
6	05 14	03 09	03 61	09 99	07 00	11 65	6
7	06 00	03 61	04 21	11 65	08 17	13 59	7
8	06 86	04 12	04 81	13 31	09 33	15 53	8
9	07 71	04 64	05 41	14 98	10 50	17 47	9
10	08 57	05 15	06 01	16 64	11 67	19 42	10
11	09 43	05 67	06 61	18 31	12 83	21 36	11
12	10 29	06 18	07 21	19 97	14 00	23 30	12
13	11 14	06 70	07 81	21 64	15 17	25 24	13
14	12 00	07 21	08 41	23 30	16 33	27 18	14
15	12 86	07 73	09 01	24 96	17 50	29 12	15
16	13 71	08 24	09 61	26 63	18 67	31 06	16
17	14 57	08 76	10 21	28 29	19 83	33 01	17
18	15 43	09 27	10 81	29 96	21 00	34 95	18
19	16 29	09 79	11 41	31 62	22 17	36 89	19
20	17 14	10 30	12 02	33 29	23 33	38 83	20
21	18 00	10 82	12 62	34 95	24 50	40 78	21
22	18 86	11 33	13 22	36 61	25 67	42 72	22
23	19 71	11 85	13 82	38 28	26 83	44 66	23
24	20 57	12 36	14 42	39 94	28 00	46 60	24
25	21 43	12 88	15 02	41 61	29 17	48 54	25
26	22 29	13 39	15 62	43 27	30 33	50 48	26
27	23 14	13 91	16 23	44 94	31 50	52 43	27
28	24 00	14 42	16 82	46 60	32 67	54 37	28
29	24 86	14 94	17 42	48 26	33 83	56 31	29
30	25 71	15 45	18 03	49 93	35 00	58 25	30
31	26 57	15 97	18 63	51 59	36 17	60 19	31
32	27 43	16 48	19 23	53 26	37 33	62 13	32
33	28 29	17 00	19 83	54 92	38 50	64 07	33
34	29 14	17 51	20 43	56 59	39 67	66 02	34
35	30 00	18 03	21 03	58 25	40 83	67 96	35
36	30 86	18 54	21 63	59 91	42 00	69 90	36
37	31 71	19 06	22 23	61 58	43 17	71 84	37
38	32 57	19 57	22 83	63 24	44 33	73 78	38
39	33 43	20 09	23 43	64 91	45 50	75 72	39
40	34 29	20 60	24 03	66 57	46 67	77 66	40
41	35 14	21 12	24 64	68 24	47 83	79 61	41
42	36 00	21 63	25 24	69 90	49 00	81 55	42
43	36 86	22 15	25 84	71 55	50 17	83 49	43
44	37 71	22 66	26 44	73 23	51 33	85 44	44
45	38 57	23 18	27 04	74 89	52 50	87 38	45
46	39 43	23 69	27 64	76 56	53 67	89 32	46
47	40 29	24 21	28 24	78 22	54 83	91 26	47
48	41 14	24 72	28 84	79 89	56 00	93 20	48
49	42 00	25 24	29 44	81 55	57 17	95 14	49
50	42 86	25 75	30 04	83 21	58 33	97 08	50

2 Rumb and three quarters is 30 deg. 56 min.

Numbers	Sines Degrees 31 N.pt.	Sines Degrees 59 N.pt.	Tangents Degrees 31 N.pt.	Tangents Degrees 59 N.pts.	Secants Degrees 31 N. pt.	Secants Degrees 59 N.pts.	Numbers
51	43 71	26 27	30 64	84 88	59 50	99 02	51
52	44 57	26 78	31 24	86 54	60 66	100 97	52
53	45 44	27 30	31 84	88 24	61 83	102 91	53
54	46 29	27 81	32 44	89 84	63 00	104 85	54
55	47 14	28 33	33 04	91 54	64 16	106 79	55
56	48 00	28 84	33 64	93 20	65 33	108 73	56
57	48 86	29 36	34 25	94 86	66 50	110 67	57
58	49 71	29 87	34 85	96 53	67 67	112 62	58
59	50 57	30 39	35 45	98 19	68 83	114 56	59
60	51 43	30 90	36 05	99 86	70 00	116 50	60
61	52 29	31 42	36 65	101 52	71 16	118 44	61
62	53 14	31 93	37 25	103 19	72 33	120 38	62
63	54 00	32 45	37 85	104 85	73 50	122 32	63
64	54 86	32 96	38 45	106 51	74 66	124 27	64
65	55 71	33 48	39 05	108 18	75 83	126 21	65
66	56 57	33 99	39 65	109 84	77 00	128 15	66
67	57 43	34 51	40 26	111 51	78 16	130 09	67
68	58 29	35 02	40 86	113 17	79 33	132 03	68
69	59 14	35 54	41 46	114 84	80 50	133 97	69
70	60 00	36 05	42 06	116 50	81 66	135 91	70
71	60 86	36 57	42 66	118 16	82 03	137 85	71
72	61 71	37 08	43 26	119 83	84 00	139 80	72
73	62 57	37 60	43 86	121 49	85 16	141 74	73
74	63 43	38 11	44 46	123 16	86 33	143 68	74
75	64 29	38 63	45 06	124 82	87 50	145 62	75
76	65 14	39 14	45 65	126 49	88 66	147 56	76
77	66 00	39 66	46 27	128 15	89 83	149 50	77
78	66 86	40 17	46 87	129 81	91 00	151 45	78
79	67 71	40 69	47 47	131 48	92 16	153 39	79
80	68 57	41 20	48 07	133 14	93 33	155 33	80
81	69 43	41 72	48 67	134 81	94 50	157 27	81
82	70 29	42 23	49 27	136 47	95 66	159 21	82
83	71 14	42 75	49 87	138 14	96 83	161 15	83
84	72 00	43 26	50 47	139 80	98 00	163 09	84
85	72 86	43 78	51 07	141 46	99 16	165 04	85
86	73 71	44 29	51 67	143 13	100 33	166 98	86
87	74 57	44 81	52 27	144 79	101 50	168 92	87
88	75 43	45 32	52 88	146 46	102 66	170 86	88
89	76 29	45 84	53 48	148 12	103 83	172 80	89
90	77 14	46 35	54 08	149 79	105 00	174 74	90
91	78 00	46 87	54 68	151 45	106 16	176 69	91
92	78 86	47 38	55 28	153 11	107 33	178 63	92
93	79 71	47 90	55 88	154 78	108 50	180 57	93
94	80 57	48 41	56 48	156 44	109 66	182 51	94
95	81 43	48 93	57 08	158 11	110 83	184 45	95
96	82 29	49 44	57 68	159 77	112 00	186 40	96
97	83 14	49 96	58 28	161 44	113 16	188 34	97
98	84 00	50 47	58 88	163 10	114 33	190 28	98
99	84 86	50 99	59 28	164 76	115 50	192 22	99
100	85 72	51 50	60 09	166 43	116 66	194 16	100

2 Rumb and three quarters is 30 deg. 56 min.

Numbers	Sines Degrees 32 N. pt	Sines Degrees 58 N. pt	Tangents Degrees 32 N. pt	Tangents Degrees 58 N. pts	Secants Degrees 32 N. pt.	Secants Degrees 58 N. pts.	Numbers
1	00 85	00 53	00 62	01 60	01 18	01 89	1
2	01 70	01 06	01 25	03 20	02 36	03 77	2
3	02 54	01 59	01 87	04 80	03 54	05 66	3
4	03 39	02 12	02 50	06 40	04 72	07 55	4
5	04 24	02 65	03 12	08 00	05 90	09 44	5
6	05 09	03 18	03 75	09 60	07 08	11 32	6
7	05 94	03 71	04 37	11 20	08 25	13 21	7
8	06 78	04 24	05 00	12 80	09 43	15 10	8
9	07 63	04 77	05 62	14 40	10 61	16 98	9
10	08 48	05 30	06 25	16 00	11 79	18 87	10
11	09 33	05 83	06 87	17 60	12 97	20 76	11
12	10 18	06 36	07 50	19 20	14 15	22 64	12
13	11 02	06 89	08 12	20 80	15 33	24 53	13
14	11 87	07 42	08 75	22 40	16 51	26 42	14
15	12 72	07 95	09 37	24 00	17 69	28 31	15
16	13 57	08 48	10 00	25 60	18 87	30 19	16
17	14 42	09 01	10 62	27 20	20 04	32 08	17
18	15 26	09 54	11 25	28 80	21 22	33 97	18
19	16 11	10 07	11 87	30 40	22 40	35 85	19
20	16 96	10 60	12 50	32 01	23 58	37 74	20
21	17 80	11 13	13 12	33 61	24 76	39 63	21
22	18 65	11 66	13 75	35 21	25 94	41 51	22
23	19 50	12 19	14 37	36 81	27 12	43 40	23
24	20 35	12 72	15 00	38 41	28 30	45 29	24
25	21 20	13 25	15 62	40 01	29 48	47 18	25
26	22 04	13 78	16 25	41 61	30 66	49 06	26
27	22 89	14 31	16 87	43 21	31 84	50 99	27
28	23 74	14 84	17 50	44 81	33 02	52 84	28
29	24 59	15 37	18 12	46 41	34 20	54 72	29
30	25 44	15 90	18 75	48 01	35 38	56 61	30
31	26 28	16 43	19 37	49 61	36 55	58 50	31
32	27 13	16 96	20 00	51 21	37 73	60 38	32
33	27 98	17 49	20 62	52 81	38 91	62 27	33
34	28 82	18 02	21 25	54 41	40 09	64 16	34
35	29 67	18 55	21 87	56 01	41 27	66 04	35
36	30 52	19 08	22 50	57 61	42 45	67 93	36
37	31 37	19 64	23 12	59 21	43 63	69 82	37
38	32 22	20 14	23 75	60 81	44 81	71 71	38
39	33 06	20 67	24 37	62 41	45 99	73 55	39
40	33 92	21 20	24 99	64 01	47 17	75 48	40
41	34 76	21 73	25 62	65 61	48 34	77 37	41
42	35 61	22 26	26 24	67 21	49 52	79 25	42
43	36 46	22 79	26 87	68 81	50 70	81 14	43
44	37 30	23 32	27 49	70 41	51 88	83 03	44
45	38 15	23 85	28 12	72 01	53 06	84 91	45
46	39 01	24 38	28 74	73 62	54 24	86 80	46
47	39 86	24 91	29 37	75 22	55 42	88 69	47
48	40 71	25 44	29 99	76 82	56 60	90 58	48
49	41 55	25 97	30 62	78 42	57 78	92 46	49
50	42 40	26 50	31 24	80 02	58 96	94 35	50

Numbers	Sines Degrees 32 N.pt.	Sines Degrees 58 N.pt.	Tangents Degrees 32 N.pt.	Tangents Degrees 58 N.pts.	Secants Degrees 32 N. pt.	Secants Degrees 58 N.pts.	Numbers
51	43 25	27 03	31 87	81 62	60 13	96 24	51
52	44 10	27 56	32 49	83 22	61 31	98 12	52
53	44 95	28 09	33 12	84 82	62 49	100 01	53
54	45 79	28 62	33 74	86 42	63 67	101 90	54
55	46 64	29 15	34 37	88 02	64 85	103 78	55
56	47 49	29 68	34 97	89 62	66 03	105 67	56
57	48 34	30 21	35 62	91 22	67 21	107 56	57
58	49 19	30 74	36 24	92 82	68 39	109 44	58
59	50 03	31 27	36 87	94 42	69 57	111 33	59
60	50 88	31 80	37 49	96 02	70 75	113 22	60
61	51 73	32 33	38 12	97 62	71 93	115 11	61
62	52 58	32 86	38 74	99 22	73 11	116 99	62
63	53 43	33 39	39 37	100 82	74 29	118 88	63
64	54 27	33 92	39 99	102 42	75 47	120 77	64
65	55 12	34 45	40 62	104 02	76 65	122 65	65
66	55 97	34 98	41 24	105 62	77 82	124 54	66
67	56 81	35 51	41 87	107 22	79 00	126 43	67
68	57 66	36 04	42 49	108 82	80 18	128 32	68
69	58 51	36 57	43 12	110 42	81 36	130 21	69
70	59 36	37 09	43 74	112 02	82 54	132 10	70
71	60 21	37 62	44 37	113 62	83 72	133 99	71
72	61 05	38 15	44 99	115 22	84 90	135 87	72
73	61 90	38 68	45 62	116 82	86 08	137 76	73
74	62 75	39 21	46 24	118 42	87 26	139 65	74
75	63 60	39 74	46 87	120 02	88 44	141 54	75
76	64 45	40 27	47 49	121 63	89 62	143 42	76
77	65 29	40 80	48 12	123 23	90 80	145 31	77
78	66 14	41 33	48 74	124 83	91 97	147 20	78
79	66 99	41 86	49 37	126 43	93 15	149 08	79
80	67 84	42 39	49 99	128 03	94 33	150 97	80
81	68 68	42 92	50 62	129 63	95 51	152 86	81
82	69 53	43 45	51 24	131 23	96 69	154 74	82
83	70 38	43 98	51 87	132 83	97 87	156 63	83
84	71 23	44 51	52 49	134 43	98 05	158 52	84
85	72 07	45 04	53 12	136 03	100 23	160 41	85
86	72 93	45 57	53 74	137 63	101 41	162 29	86
87	73 77	46 10	54 37	139 23	102 59	164 18	87
88	74 62	46 63	54 99	140 83	103 77	166 07	88
89	75 47	47 16	55 62	142 43	104 95	167 95	89
90	76 32	47 69	56 24	144 03	106 13	169 84	90
91	77 16	48 22	56 87	145 63	107 31	171 73	91
92	78 02	48 75	57 49	147 23	108 49	173 62	92
93	78 86	49 28	58 12	148 83	109 67	175 51	93
94	79 72	49 81	58 74	150 43	110 85	177 39	94
95	80 56	50 34	59 37	152 03	112 03	179 28	95
96	81 41	50 87	59 99	153 63	113 20	181 16	96
97	82 26	51 40	60 62	155 23	114 38	183 05	97
98	83 11	51 93	61 24	156 83	115 56	184 94	98
99	83 96	52 46	61 87	158 43	116 74	186 82	99
100	84 80	52 99	62 49	160 03	117 93	188 71	100

Numbers	Sines Degrees 33 N. pt		Sines Degrees 57 N. pt		Tangents Degrees 33 N. pt		Tangents Degrees 57 N. pt		Secants Degrees 33 N. pt.		Secants Degrees 57 N. pts.		Numbers
1	00	84	00	54	00	65	01	54	01	19	01	84	1
2	01	68	01	09	01	30	03	08	02	38	03	67	2
3	02	52	01	63	01	95	04	62	03	58	05	51	3
4	03	36	02	18	02	60	06	16	04	77	07	34	4
5	04	20	02	72	03	25	07	70	05	96	09	18	5
6	05	03	03	27	03	90	09	24	07	15	11	02	6
7	05	87	03	81	04	55	10	78	08	35	12	85	7
8	06	71	04	36	05	20	12	32	09	54	14	69	8
9	07	55	04	90	05	85	13	86	10	73	16	52	9
10	08	39	05	45	06	51	15	40	11	92	18	36	10
11	09	23	05	99	07	14	16	94	13	12	20	20	11
12	10	07	06	55	07	79	18	48	14	31	22	04	12
13	10	91	07	08	08	44	20	02	15	50	23	87	13
14	11	75	07	62	09	09	21	56	16	69	25	71	14
15	12	59	08	17	09	74	23	10	17	88	27	54	15
16	13	42	08	71	10	39	24	64	18	08	29	38	16
17	14	26	09	26	11	04	26	18	20	27	31	22	17
18	15	10	09	80	11	69	27	72	21	46	33	06	18
19	15	94	10	35	12	34	29	26	22	65	34	89	19
20	16	78	10	89	12	99	30	80	23	85	36	72	20
21	17	62	11	44	13	64	32	34	25	04	38	55	21
22	18	46	11	98	14	29	33	88	26	23	40	39	22
23	19	30	12	52	14	94	35	42	27	43	42	23	23
24	20	13	13	07	15	59	36	96	28	62	44	07	24
25	20	97	13	61	16	24	38	50	29	81	45	90	25
26	21	81	14	16	16	89	40	04	31	00	47	73	26
27	22	65	14	70	17	54	41	58	32	19	49	56	27
28	23	49	15	25	18	19	43	12	33	38	51	40	28
29	24	33	15	79	18	84	44	66	34	58	53	23	29
30	25	17	16	34	19	48	46	20	35	77	55	08	30
31	26	01	16	88	20	13	47	74	36	96	56	91	31
32	26	85	17	43	20	78	49	28	38	15	58	74	32
33	27	69	17	97	21	43	50	82	39	35	60	57	33
34	28	52	18	51	22	08	52	36	40	54	62	42	34
35	29	36	19	06	22	73	53	90	41	73	64	25	35
36	30	20	19	60	23	38	55	44	42	92	66	09	36
37	31	04	20	15	24	03	56	98	44	12	67	92	37
38	31	88	20	69	24	68	58	52	45	31	69	75	38
39	32	72	21	24	25	33	60	06	46	50	71	58	39
40	33	56	21	79	25	98	61	60	47	70	73	44	40
41	34	40	22	33	26	63	63	14	48	89	75	27	41
42	35	23	22	87	27	28	64	68	50	08	77	11	42
43	36	07	23	42	27	93	66	22	51	27	78	94	43
44	36	91	23	96	28	58	67	76	52	46	80	77	44
45	37	75	24	50	29	23	69	30	53	65	82	60	45
46	38	59	25	05	29	88	70	84	54	85	84	46	46
47	39	43	25	59	30	53	72	38	56	04	86	29	47
48	40	27	26	14	31	18	73	92	57	23	88	13	48
49	41	11	26	68	31	83	75	45	58	43	89	96	49
50	41	95	27	23	32	47	77	00	59	62	91	80	50

Numbers	Sines Degrees 33 N.pt.	Sines Degrees 57 N.pt.	Tangents Degrees 33 N.pt.	Tangents Degrees 57 N.pts.	Secants Degrees 33 N. pt.	Secants Degrees 57 N.pts.	Numbers
51	42 79	27 79	33 12	78 53	60 81	93 66	51
52	43 62	28 33	33 77	80 07	62 00	95 49	52
53	44 46	28 87	34 42	81 61	63 19	97 32	53
54	45 30	29 42	35 07	83 15	64 38	99 16	54
55	46 14	29 96	35 62	84 69	65 58	101 00	55
56	46 98	30 50	36 37	86 23	66 77	102 83	56
57	47 82	31 05	37 02	87 77	67 96	104 66	57
58	48 66	31 59	37 67	89 31	69 15	106 50	58
59	49 50	32 13	38 32	90 85	70 35	108 33	59
60	50 34	32 68	38 96	92 39	71 54	110 17	60
61	51 18	33 22	39 62	93 93	72 73	112 02	61
62	52 02	33 78	40 27	95 47	73 92	113 85	62
63	52 86	34 32	40 92	97 01	75 12	115 67	63
64	53 70	34 86	41 57	98 55	76 31	117 52	64
65	54 53	35 41	42 22	100 09	77 50	119 36	65
66	55 32	35 95	42 87	101 63	78 69	121 20	66
67	56 21	36 49	43 52	103 17	79 88	123 04	67
68	57 05	37 04	44 17	104 71	81 08	124 87	68
69	57 89	37 58	44 82	106 25	82 27	126 71	69
70	58 73	38 12	45 46	107 79	83 47	128 53	70
71	59 57	38 67	46 11	109 33	84 66	130 37	71
72	60 41	39 21	46 76	110 87	85 85	132 21	72
73	61 24	39 77	47 41	112 41	87 04	134 05	73
74	62 08	40 31	48 06	113 95	88 23	135 88	74
75	62 92	40 85	48 61	115 49	89 43	137 71	75
76	63 76	41 46	49 36	117 03	90 62	139 54	76
77	64 60	41 94	50 01	118 57	91 81	141 38	77
78	65 44	42 48	50 66	120 11	93 00	143 22	78
79	66 28	43 03	51 31	121 65	94 19	145 06	79
80	67 12	43 57	51 95	123 19	95 39	146 89	80
81	67 96	44 11	52 61	124 73	96 58	148 72	81
82	68 80	44 66	53 26	126 27	97 77	150 55	82
83	69 63	45 20	53 91	127 81	98 96	152 39	83
84	70 47	45 76	54 56	129 35	100 15	154 22	84
85	71 31	46 30	55 21	130 87	101 35	156 07	85
86	72 15	46 84	55 86	132 43	102 54	157 90	86
87	72 99	47 39	56 51	133 97	103 73	159 73	87
88	73 83	47 93	57 16	135 51	104 92	161 56	88
89	74 67	48 47	57 81	137 05	106 12	163 41	89
90	75 51	49 02	58 45	138 59	107 32	165 25	90
91	76 35	49 56	59 10	140 13	108 51	167 09	91
92	77 19	50 10	59 75	141 67	109 70	168 92	92
93	78 03	50 65	60 40	143 21	110 89	170 75	93
94	78 87	51 19	61 05	144 75	112 08	172 58	94
95	79 71	51 75	61 60	146 29	113 27	174 44	95
96	80 54	52 29	62 35	147 83	114 46	176 27	96
97	81 38	52 83	63 00	149 37	115 65	178 11	97
98	82 22	53 38	63 65	150 91	116 85	179 94	98
99	83 06	53 92	64 30	152 45	118 04	181 77	99
100	83 90	54 46	64 94	153 99	119 24	183 61	100

5 Rumbs is 56 deg. 15 min.

Numbers	Sines Degrees 34 N.	pt	56 N.	pt	Tangents Degrees 34 N.	pt	56 N.	pt	Secants Degrees 34 N.	pt.	56 N.	pts.	Numbers
1	08	83	08	56	08	67	01	48	01	21	01	79	1
2	21	66	01	12	01	35	02	97	02	41	03	58	2
3	08	49	01	68	02	02	04	45	03	62	05	36	3
4	03	32	02	24	02	70	05	99	04	82	07	15	4
5	04	14	02	80	03	37	07	41	05	03	08	94	5
6	04	97	03	36	04	05	08	90	07	24	10	73	6
7	05	80	03	91	04	72	10	35	08	44	12	52	7
8	06	63	04	47	05	40	11	86	09	65	14	31	8
9	07	46	05	03	06	07	13	34	10	86	16	09	9
10	08	29	05	59	06	75	14	82	12	06	17	88	10
11	09	11	06	15	07	42	16	31	13	27	19	67	11
12	09	94	06	71	08	10	17	80	14	47	21	46	12
13	10	77	07	27	08	77	19	28	15	68	23	25	13
14	11	60	07	83	09	45	20	76	16	89	25	04	14
15	12	43	08	39	10	12	22	24	18	09	26	83	15
16	13	26	08	94	10	90	23	73	19	30	28	62	16
17	14	08	09	50	11	47	25	21	20	51	30	41	17
18	15	93	10	06	12	15	26	70	21	71	32	19	18
19	15	74	10	62	12	72	28	18	22	92	33	98	19
20	16	58	11	18	13	49	29	65	24	12	35	77	20
21	17	40	11	74	14	17	31	14	25	33	37	50	21
22	18	23	12	30	14	85	32	63	26	53	39	35	22
23	19	05	13	76	15	52	34	11	27	74	41	14	23
24	19	88	13	42	16	20	35	60	28	95	42	93	24
25	20	71	14	98	16	87	37	08	30	15	44	72	25
26	21	55	14	54	17	54	38	55	31	36	46	51	26
27	22	38	15	09	18	22	40	04	32	56	48	29	27
28	23	21	15	65	18	90	41	53	33	77	50	08	28
29	24	04	16	21	19	57	43	00	34	98	51	87	29
30	24	87	16	78	20	24	44	48	36	19	53	67	30
31	25	70	17	33	20	92	45	97	37	39	55	44	31
32	26	53	17	89	21	59	47	45	38	60	57	23	32
33	27	36	18	45	22	27	48	93	39	80	59	02	33
34	28	18	19	01	22	95	50	41	41	01	60	81	34
35	29	01	19	57	23	62	51	90	42	21	62	59	35
36	29	84	20	13	24	25	53	36	43	42	64	38	36
37	30	67	20	69	24	95	54	86	44	063	66	17	37
38	31	50	21	25	25	64	56	34	45	83	67	96	38
39	32	33	21	81	26	32	57	83	47	04	69	75	39
40	33	16	22	37	26	98	59	30	48	25	71	53	40
41	33	99	22	92	27	65	60	80	49	45	73	32	41
42	34	82	23	48	28	33	62	28	50	066	75	11	42
43	35	65	24	04	29	00	63	76	51	87	76	89	43
44	36	48	24	60	29	67	65	24	53	07	78	68	44
45	37	31	25	19	30	35	66	73	54	28	80	47	45
46	38	14	25	72	31	02	68	21	55	46	82	26	46
47	38	97	26	28	31	70	69	70	56	079	84	05	47
48	39	80	26	84	32	37	71	18	57	90	85	84	48
49	40	62	27	40	33	05	72	65	59	10	87	63	49
50	41	45	27	96	33	72	74	13	60	31	89	42	50

3 Rumb is 33 deg. 45 min.

Numbers	Sines Degrees 34 N.pt.	56 N.pt.	Tangents Degrees 34 N.pt.	56 N.pts.	Secants Degrees 34 N. pt.	56 N.pts.	Numbers
51	42 28	28 51	34 40	75 63	61 51	91 21	51
52	43 11	29 07	35 07	77 11	62 72	92 99	52
53	43 51 94	29 63	35 75	78 960	63 92	94 78	53
54	44 47	30 19	36 42	80 08	65 13	96 37	54
55	45 62	30 75	37 10	81 55	66 34	98 36	55
56	46 43	31 31	37 77	83 04	67 54	100 15	56
57	47 26	31 87	38 45	84 53	68 75	101 94	57
58	48 56 09	32 43	39 12	86 00	69 96	103 73	58
59	48 92	32 99	39 93	87 48	71 16	105 52	59
60	49 74	33 55	40 46	88 96	72 37	107 30	60
61	50 57	34 10	41 15	90 45	73 58	109 09	61
62	51 40	34 66	41 72	91 93	74 78	110 86	62
63	52 23	35 22	42 49	93 41	75 99	112 67	63
64	53 06	35 79	43 17	94 90	77 20	114 46	64
65	53 89	36 34	43 85	96 38	78 40	116 25	65
66	54 72	36 90	44 52	97 00	79 61	118 04	66
67	55 55	37 46	45 20	99 34	80 82	119 83	67
68	56 38	38 02	45 87	100 83	82 12	121 62	68
69	57 20	38 58	46 54	102 31	83 23	123 40	69
70	58 03	39 14	47 22	103 78	84 43	125 18	70
71	58 86	39 70	47 90	105 27	85 64	126 97	71
72	59 69	40 26	48 57	106 75	86 85	128 74	72
73	60 52	40 82	49 24	108 23	87 05	130 55	73
74	61 35	41 38	49 92	109 72	89 26	132 34	74
75	62 18	41 93	50 59	111 20	90 47	134 13	75
76	63 00	42 49	51 27	112 69	91 67	135 91	76
77	63 83	43 05	51 94	114 17	92 88	137 70	77
78	64 76 66	43 61	52 62	115 64	94 08	139 49	78
79	65 49	44 17	53 29	117 13	95 29	141 28	79
80	66 32	44 74	53 96	118 61	96 50	143 06	80
81	67 15	45 29	54 64	120 10	97 70	144 85	81
82	67 98	45 85	55 32	121 59	98 91	146 64	82
83	68 80	46 41	55 98	123 07	100 12	148 43	83
84	69 63	46 97	56 65	124 54	101 32	150 22	84
85	70 46	47 52	57 33	126 03	102 53	152 00	85
86	71 29	48 08	58 00	127 52	103 74	153 79	86
87	72 12	48 64	58 67	128 99	104 94	155 58	87
88	72 95	49 20	59 34	130 47	106 15	157 37	88
89	73 78	49 76	60 02	131 96	107 36	159 16	89
90	74 61	50 33	60 70	133 41	108 56	160 95	90
91	75 44	50 89	61 37	134 90	109 77	162 71	91
92	76 27	51 45	62 05	136 39	110 98	164 53	92
93	77 10	52 00	62 72	137 88	112 18	166 32	93
94	77 93	52 56	63 40	139 36	113 39	168 10	94
95	78 76	53 12	64 07	140 84	114 60	169 89	95
96	79 59	53 68	64 75	142 32	115 80	171 68	96
97	80 42	54 24	65 42	143 81	117 01	173 47	97
98	81 25	54 80	66 10	145 28	118 21	175 26	98
99	82 08	55 36	66 77	146 77	119 42	177 05	99
100	82 90	55 92	67 45	148 26	120 62	178 83	100

3 Rumb is 33 deg. 45 min.

Numbers	Sines Degrees 35 N.pt	Sines Degrees 55 N.pt	Tangents Degrees 35 N.pt.	Tangents Degrees 55 N.pts.	Secants Degrees 35 N. pt	Secants Degrees 55 N. pts.	Numbers
1	00 82	00 57	00 70	01 43	01 22	01 74	1
2	01 64	01 15	01 40	02 86	02 44	03 49	2
3	02 46	01 72	02 10	04 28	03 66	05 23	3
4	03 28	02 29	02 80	05 71	04 88	06 97	4
5	04 10	02 87	03 50	07 14	06 10	08 72	5
6	04 92	03 44	04 20	08 57	07 32	10 46	6
7	05 73	04 02	04 90	10 00	08 55	12 20	7
8	06 55	04 59	05 60	11 43	09 77	13 95	8
9	07 37	05 16	06 30	12 85	10 99	15 69	9
10	08 19	05 74	07 00	14 28	12 21	17 44	10
11	09 01	06 31	07 70	15 71	13 43	19 18	11
12	09 83	06 89	08 40	17 14	14 65	20 92	12
13	10 65	07 46	09 10	18 57	15 87	22 67	13
14	11 47	08 04	09 80	19 99	17 09	24 41	14
15	12 29	08 61	10 50	21 42	18 31	26 15	15
16	13 11	09 18	11 20	22 84	19 54	27 90	16
17	13 93	09 76	11 90	24 28	20 76	29 64	17
18	14 74	10 33	12 60	25 70	21 98	31 39	18
19	15 56	10 91	13 30	27 13	23 20	33 13	19
20	16 38	11 47	14 00	28 56	24 42	34 87	20
21	17 21	12 05	14 70	30 00	25 64	36 62	21
22	18 03	12 62	15 40	31 43	26 86	38 36	22
23	18 85	13 19	16 10	32 86	28 08	40 10	23
24	19 67	13 77	16 80	34 28	29 30	41 85	24
25	20 48	14 34	17 50	35 71	30 52	43 59	25
26	21 30	14 92	18 21	37 14	31 74	45 34	26
27	22 12	15 48	18 91	38 56	32 96	47 08	27
28	22 95	16 06	19 61	40 00	34 18	48 82	28
29	23 76	16 63	20 31	41 43	35 40	50 57	29
30	24 58	17 21	21 01	42 85	36 62	52 30	30
31	25 39	17 78	21 71	44 27	37 84	54 05	31
32	26 22	18 35	22 41	45 70	39 06	55 80	32
33	27 04	18 93	23 11	47 13	40 28	57 54	33
34	27 86	19 49	23 81	48 56	41 50	59 29	34
35	28 68	20 07	24 51	49 99	42 73	61 03	35
36	29 49	20 64	25 21	51 42	43 95	62 77	36
37	30 31	21 22	25 91	52 84	45 17	64 52	37
38	31 14	21 79	26 61	54 27	46 39	66 26	38
39	31 96	22 35	27 31	55 70	47 61	68 00	39
40	32 77	22 94	28 01	57 13	48 83	69 74	40
41	33 59	23 50	28 71	58 56	50 05	71 49	41
42	34 41	24 08	29 41	59 98	51 27	73 23	42
43	35 23	24 65	30 11	61 41	52 49	74 97	43
44	36 05	25 23	30 81	62 83	53 71	76 72	44
45	36 87	25 80	31 51	64 27	54 93	78 46	45
46	37 69	26 36	32 21	65 69	56 15	80 20	46
47	38 50	26 94	32 91	67 12	57 37	81 95	47
48	39 32	27 52	33 61	68 55	58 59	83 69	48
49	40 14	28 10	34 31	69 98	59 81	85 44	49
50	40 96	28 68	35 01	71 41	61 04	87 18	50

Numbers	Sines Degrees 35 N.pt.	Sines Degrees 55 N.pt.	Tangents Degrees 35 N.pt.	Tangents Degrees 55 N.pts.	Secants Degrees 35 N. pt.	Secants Degrees 55 N.pts.	Numbers
51	41 78	29 25	35 71	72 84	62 26	88 92	51
52	42 60	29 82	36 41	74 26	63 48	90 67	52
53	43 53 41	30 39	37 11	75 89 59	64 70	92 41	53
54	44 24	30 96	37 81	77 12	65 92	94 15	54
55	45 06	31 54	38 51	78 55	67 14	95 90	55
56	45 88	32 12	39 21	79 98	68 36	97 64	56
57	46 70	32 70	39 91	81 41	69 58	99 39	57
58	47 51	33 27	40 61	82 83	70 80	101 13	58
59	48 33	33 84	41 31	84 26	72 02	102 87	59
60	49 15	34 42	42 01	85 69	73 25	104 61	60
61	49 97	34 98	42 71	87 12	74 47	106 36	61
62	50 79	35 56	43 41	88 55	75 69	108 10	62
63	51 61	36 14	44 11	89 98	76 91	109 85	63
64	52 42	36 72	44 81	91 41	78 13	111 59	64
65	53 25	37 29	45 51	92 83	79 35	113 34	65
66	54 07	37 86	46 21	94 26	80 57	115 08	66
67	54 89	38 44	46 91	95 69	81 79	116 82	67
68	55 71	39 00	47 61	97 12	83 01	118 57	68
69	56 52	39 57	48 31	98 55	84 23	120 32	69
70	57 34	40 15	49 01	99 97	85 46	122 04	70
71	58 16	40 72	49 71	101 40	86 68	123 80	71
72	58 98	41 29	50 41	102 82	87 90	125 54	72
73	59 80	41 87	51 11	104 25	89 12	127 29	73
74	60 62	42 44	51 81	105 68	90 34	129 03	74
75	61 44	43 02	52 51	107 11	91 56	130 77	75
76	62 27	43 59	53 22	108 54	92 78	132 52	76
77	63 09	44 16	53 92	109 97	94 00	134 26	77
78	63 91	44 74	54 62	111 40	95 22	136 00	78
79	64 73	45 31	55 32	112 83	96 44	137 74	79
80	65 54	45 89	56 02	114 26	97 66	139 48	80
81	66 36	46 46	56 72	115 69	98 88	141 23	81
82	67 18	47 04	57 42	117 12	100 10	142 97	82
83	68 00	47 61	58 12	118 55	101 32	144 72	83
84	68 82	48 18	58 82	119 98	102 54	146 46	84
85	69 64	48 76	59 52	121 41	103 76	148 20	85
86	70 46	49 33	60 22	122 83	104 98	149 95	86
87	71 28	49 91	60 92	124 26	106 20	151 69	87
88	72 10	50 47	61 62	125 69	107 42	153 44	88
89	72 92	51 05	62 32	127 12	108 64	155 18	89
90	73 73	51 62	63 02	128 54	109 87	156 92	90
91	74 55	52 19	63 72	129 97	111 09	158 67	91
92	75 37	52 77	64 42	131 40	112 31	160 41	92
93	76 19	53 34	65 12	132 83	113 53	162 15	93
94	77 01	53 92	65 82	134 25	114 75	163 90	94
95	77 83	54 48	66 52	135 68	115 97	165 64	95
96	78 65	55 06	67 22	137 11	117 19	167 39	96
97	79 47	55 63	67 92	138 54	118 41	169 13	97
98	80 29	56 21	68 62	139 97	120 63	170 87	98
99	81 11	56 78	69 32	141 40	121 85	172 62	99
100	81 92	57 36	70 02	142 82	122 08	174 35	100

Numbers	Sines Degrees 36 N.pt	Sines Degrees 54 N.pt	Tangents Degrees 36 N.pt.	Tangents Degrees 54 N.pts.	Secants Degrees 36 N. pt	Secants Degrees 54 N. pts.	Numbers
1	00 81	00 59	00 73	01 38	01 24	01 70	1
2	01 62	01 18	01 45	02 75	02 47	03 40	2
3	02 43	01 76	02 18	04 13	03 71	05 10	3
4	03 24	02 35	02 91	05 51	04 94	06 80	4
5	04 05	02 94	03 63	06 88	06 18	08 51	5
6	04 85	03 53	04 36	08 26	07 42	10 21	6
7	05 66	04 11	05 09	09 63	08 65	11 91	7
8	06 47	04 70	05 82	11 01	09 89	13 61	8
9	07 28	05 29	06 54	12 39	11 12	15 31	9
10	08 09	05 88	07 27	13 76	12 36	17 02	10
11	08 90	06 46	08 00	15 14	13 59	18 71	11
12	09 71	07 05	08 73	16 52	14 83	20 42	12
13	10 52	07 64	09 45	17 89	16 06	22 12	13
14	11 33	08 23	10 18	19 27	17 30	23 82	14
15	12 14	08 82	10 91	20 64	18 53	25 52	15
16	12 94	09 41	11 63	22 02	19 77	27 22	16
17	13 75	10 00	12 39	23 40	21 01	28 92	17
18	14 56	10 59	13 09	24 77	22 25	30 62	18
19	15 37	11 18	13 81	26 15	23 48	32 33	19
20	16 18	11 76	14 53	27 53	24 72	34 03	20
21	16 99	12 35	15 27	28 90	25 95	35 73	21
22	17 80	12 94	15 99	30 28	27 19	37 43	22
23	18 61	13 53	16 72	31 65	28 43	39 13	23
24	19 42	14 11	17 44	33 03	29 66	40 83	24
25	20 12	14 70	18 17	34 41	30 90	42 53	25
26	21 03	15 29	18 90	35 78	32 13	44 24	26
27	21 84	15 88	19 62	37 16	33 37	45 94	27
28	22 65	16 46	20 35	38 54	34 60	47 64	28
29	23 46	17 05	21 08	39 91	35 84	49 34	29
30	24 27	17 63	21 80	41 29	37 08	51 04	30
31	25 08	18 22	22 52	42 66	38 31	52 74	31
32	25 89	18 81	23 26	44 04	39 54	54 44	32
33	26 70	19 40	23 98	45 42	40 78	56 14	33
34	27 51	19 99	24 71	46 79	42 02	57 84	34
35	28 32	20 58	25 43	48 17	43 26	59 55	35
36	29 12	21 17	26 16	49 55	44 49	61 25	36
37	29 93	21 75	26 89	50 92	45 73	62 95	37
38	30 74	22 34	27 61	52 30	46 96	64 65	38
39	31 55	22 93	28 34	53 67	48 20	66 35	39
40	32 36	23 51	29 06	55 06	49 44	68 05	40
41	33 17	24 10	29 79	56 43	50 67	69 75	41
42	33 98	24 69	30 51	57 80	51 91	71 45	42
43	34 79	25 28	31 25	59 18	53 14	73 16	43
44	35 60	25 87	31 97	60 56	54 38	74 86	44
45	36 41	26 45	32 70	61 93	55 61	76 56	45
46	37 21	27 04	33 42	63 31	56 85	78 26	46
47	38 02	27 62	34 15	64 68	58 09	79 96	47
48	38 83	28 21	34 88	66 06	59 32	81 66	48
49	39 64	28 80	35 60	67 44	60 56	83 36	49
50	40 45	29 39	36 33	68 82	61 80	85 06	50

Numbers	Sines Degrees 36 N.pt.	Sines Degrees 54 N.pt.	Tangents Degrees 36 N.pt.	Tangents Degrees 54 N.pts.	Secants Degrees 36 N. pt.	Secants Degrees 54 N.pts.	Numbers
51	41 26	29 98	37 05	79 19	63 04	86 77	51
52	42 07	30 57	37 78	71 57	64 27	88 47	52
53	42 88	31 16	38 50	72 94	65 50	90 17	53
54	43 69	31 74	39 24	74 32	66 74	91 87	54
55	44 50	32 33	39 96	75 69	67 97	93 57	55
56	45 30	32 92	40 69	77 07	69 21	95 27	56
57	46 11	33 50	41 41	78 45	70 45	96 97	57
58	46 92	34 09	42 14	79 83	71 68	98 68	58
59	47 73	34 68	42 87	81 20	72 92	100 38	59
60	48 54	35 27	43 59	82 58	74 17	102 08	60
61	49 35	35 86	44 32	83 95	75 42	103 78	61
62	50 16	36 4	45 04	85 33	76 63	105 48	62
63	50 97	37 03	45 87	86 70	77 87	107 18	63
64	51 78	37 61	46 49	88 08	79 11	108 88	64
65	52 59	38 20	47 23	89 46	80 34	110 58	65
66	53 39	38 79	47 95	90 84	81 58	112 29	66
67	54 20	39 38	48 68	92 21	82 82	113 99	67
68	55 01	39 97	49 40	93 59	84 06	115 69	68
69	55 82	40 56	50 13	94 96	85 29	117 39	69
70	56 63	41 15	50 86	96 35	86 53	119 09	70
71	57 44	41 73	51 58	97 71	87 76	120 79	71
72	58 25	42 32	52 31	99 09	89 00	122 49	72
73	59 06	42 91	53 03	100 47	90 24	124 19	73
74	59 87	43 49	53 86	101 85	91 47	125 89	74
75	60 68	44 08	54 48	103 22	92 71	127 59	75
76	61 48	44 67	55 22	104 60	93 94	129 30	76
77	62 29	45 26	55 94	105 97	95 18	131 00	77
78	63 10	45 85	56 67	107 35	96 42	132 70	78
79	63 91	46 43	57 39	108 73	97 65	134 40	79
80	64 72	47 02	58 12	110 11	98 89	136 10	80
81	65 53	47 60	58 85	111 48	100 12	137 80	81
82	66 34	48 19	59 53	112 86	101 36	139 50	82
83	67 14	48 78	60 30	114 23	102 59	141 21	83
84	67 96	49 37	61 02	115 61	103 83	142 91	84
85	68 77	49 96	62 85	116 98	105 06	144 61	85
86	69 57	50 55	62 47	118 36	106 30	146 31	86
87	70 38	51 14	63 21	119 74	107 53	148 01	87
88	71 19	51 72	63 93	121 12	108 77	149 71	88
89	72 00	52 31	64 66	122 50	110 01	151 42	89
90	72 81	52 90	65 39	123 88	111 25	153 12	90
91	73 62	53 48	66 11	125 25	112 48	154 82	91
92	74 43	54 07	66 84	126 63	113 72	156 52	92
93	75 24	54 66	67 56	128 01	114 95	158 22	93
94	76 05	55 25	68 29	129 38	116 19	159 92	94
95	76 86	55 84	69 01	130 75	117 43	161 62	95
96	77 66	56 43	69 84	132 13	118 66	163 33	96
97	78 47	57 02	70 46	133 51	119 90	165 03	97
98	79 28	57 60	71 20	134 88	121 13	166 73	98
99	80 09	58 19	71 92	136 26	122 37	168 43	99
100	80 90	58 78	72 65	137 64	123 61	170 15	100

Numbers	Secants Degrees 37 N. pt	Secants Degrees 53 N. pts.	Tangents Degrees 37 N. pt.	Tangents Degrees 53 N. pts.	Sines Degrees 37 N. pt	Sines Degrees 53 N. pt	Numbers
1	01 25	01 66	00	01 33	00	00	1
2	difference 02 50	difference 03 32	difference 01	difference 02 69	difference 01	difference 01	2
3	03 76	04 98	02	03 98	02	02	3
4	05 01	06 65	03 01	05 31	03	03	4
5	06 26	08 31	03 77	06 64	03 99	03 01	5
6	07 51	09 97	04 52	07 96	04 79	03 61	6
7	08 76	11 63	05 27	09 30	05 59	04 21	7
8	10 02	13 29	06 03	10 62	06 39	04 81	8
9	11 27	14 95	06 78	11 94	07 19	05 42	9
10	12 52	16 62	07 54	13 27	07 99	06 02	10
11	13 77	18 28	08 29	14 60	08 78	06 62	11
12	15 03	19 94	09 04	15 92	09 58	07 22	12
13	16 28	21 60	09 80	17 25	10 38	07 82	13
14	17 53	23 26	10 55	18 58	11 18	08 43	14
15	18 78	24 92	11 30	19 91	11 98	09 03	15
16	20 03	26 58	12 06	21 23	12 78	09 63	16
17	21 29	28 23	12 81	22 57	13 58	10 23	17
18	22 54	29 91	13 56	23 89	14 38	10 83	18
19	23 79	31 57	14 32	25 22	15 17	11 44	19
20	25 04	33 23	15 07	26 54	15 97	12 04	20
21	26 30	34 89	15 82	27 86	16 77	12 64	21
22	27 55	36 55	16 58	29 20	17 57	13 24	22
23	28 80	38 22	17 33	30 52	18 37	13 84	23
24	30 06	39 88	18 09	31 84	19 17	14 44	24
25	31 31	41 54	18 84	33 17	19 97	15 05	25
26	32 56	43 20	19 59	34 50	20 77	15 65	26
27	33 71	44 86	20 35	35 82	21 56	16 25	27
28	35 07	46 52	21 10	37 15	22 36	16 85	28
29	36 32	48 18	21 85	38 48	23 16	17 45	29
30	37 56	49 85	22 61	39 81	23 96	18 05	30
31	38 82	51 51	23 36	41 13	24 76	18 65	31
32	40 07	53 17	24 11	42 47	25 56	19 26	32
33	41 33	54 83	24 87	43 79	26 36	19 86	33
34	42 58	56 49	25 62	45 11	27 15	20 46	34
35	43 83	58 15	26 37	46 44	27 95	21 06	35
36	45 07	59 82	27 13	47 76	28 75	21 66	36
37	46 34	61 48	27 88	49 10	29 55	22 27	37
38	47 59	63 14	28 64	50 41	30 35	22 87	38
39	48 84	64 80	29 39	51 74	31 15	23 47	39
40	50 09	66 47	30 14	53 08	31 95	24 07	40
41	51 35	68 12	30 90	54 40	32 74	24 67	41
42	52 60	69 78	31 65	55 72	33 54	25 27	42
43	53 75	71 45	32 40	57 05	34 34	25 88	43
44	55 12	73 11	33 16	58 38	35 14	26 48	44
45	56 36	74 77	33 91	59 71	35 94	27 08	45
46	57 61	76 43	34 66	61 03	36 74	27 68	46
47	58 86	78 09	35 42	62 37	37 54	28 28	47
48	60 11	79 75	36 17	63 69	38 33	28 89	48
49	61 36	81 42	36 92	65 01	39 13	29 49	49
50	62 62	83 08	37 68	66 35	39 93	30 09	50

3 Rumb and a quarter is 36 deg. 34 min.

3 Rumb and a quarter is 36 deg. 34 min.

Numbers	Sines Degrees 37 N.pt.	Sines Degrees 53 N.pt.	Tangents Degrees 37 N.pt.	Tangents Degrees 53 N.pts.	Secants Degrees 37 N. pt.	Secants Degrees 53 N.pts.	Numbers
51	40 73	30 69	38 43	62 66	63 86	84 74	51
52	41 53	31 29	39 19	64 99	65 12	86 40	52
53	42 33	31 90	39 94	70 32	66 37	88 06	53
54	43 13	32 50	40 69	71 65	67 62	89 73	54
55	43 93	33 10	41 45	72 97	68 87	91 39	55
56	44 72	33 77	42 20	74 31	70 13	93 05	56
57	45 52	34 30	42 95	75 62	71 38	94 71	57
58	46 32	34 90	43 71	76 95	72 63	96 37	58
59	47 12	35 51	44 46	78 28	73 88	98 03	59
60	47 92	36 11	45 21	79 62	75 13	99 70	60
61	48 72	36 71	45 97	80 94	76 39	101 36	61
62	49 52	37 31	46 73	82 26	77 64	103 02	62
63	50 31	37 91	47 47	83 59	78 89	104 68	63
64	51 11	38 52	48 23	84 92	80 14	106 34	64
65	51 91	39 12	48 98	86 24	81 40	108 00	65
66	52 71	39 72	49 74	87 58	82 65	109 66	66
67	53 51	40 32	50 49	88 90	83 90	111 32	67
68	54 31	40 92	51 24	90 22	85 16	112 98	68
69	55 11	41 53	52 00	91 55	86 41	114 65	69
70	55 90	42 13	52 75	92 89	87 65	116 31	70
71	56 70	42 73	53 50	94 21	88 81	117 97	71
72	57 50	43 33	54 26	95 53	90 17	119 63	72
73	58 30	43 95	55 01	96 85	91 42	121 29	73
74	59 10	44 53	55 77	98 18	92 66	122 95	74
75	59 90	45 14	56 52	99 51	93 92	124 62	75
76	60 69	45 74	57 27	100 83	95 17	126 28	76
77	61 49	46 34	58 03	102 16	96 43	127 94	77
78	62 29	46 94	58 79	103 49	97 68	129 60	78
79	63 08	47 54	59 54	104 82	98 93	131 26	79
80	63 88	48 14	60 28	106 16	100 17	132 93	80
81	64 69	48 75	61 04	107 48	101 44	134 58	81
82	65 49	49 35	61 80	108 80	102 69	136 25	82
83	66 29	49 95	62 55	110 13	103 94	137 91	83
84	67 09	50 51	63 30	111 45	105 19	139 57	84
85	67 89	51 15	64 06	112 77	106 45	141 23	85
86	68 68	51 75	64 81	114 11	107 70	142 89	86
87	69 48	52 36	65 56	115 43	108 95	144 55	87
88	70 28	52 96	66 32	116 75	110 21	145 22	88
89	71 08	53 56	66 87	118 09	111 46	147 88	89
90	71 88	54 16	67 82	119 43	112 70	149 55	90
91	72 68	54 76	68 58	120 75	113 96	151 20	91
92	73 47	55 36	69 33	122 07	115 21	152 86	92
93	74 27	55 97	70 09	123 40	116 46	154 52	93
94	75 07	56 57	70 84	124 73	117 72	156 18	94
95	75 87	57 17	71 59	126 06	118 96	157 85	95
96	76 67	57 77	72 35	127 40	120 22	159 51	96
97	77 47	58 37	73 10	128 71	121 47	161 17	97
98	78 27	58 98	73 85	130 05	122 72	162 83	98
99	79 06	59 58	74 61	131 37	123 97	164 49	99
100	79 86	60 18	75 36	132 70	125 22	166 16	100

4 Rumb and three quarters is 53 deg. 26 min.

Numbers	Sines Degrees				Tangents Degrees				Secants Degrees				Numbers
	38		52		38		52		38		52		
	N. pt		N. pt		N. pt.		N. pts.		N. pt		N. pts.		
1	00	79	00	61	00	78	01	28	01	27	01	62	1
2	01	58	01	23	01	56	02	56	02	54	03	25	2
3	02	36	01	85	02	34	03	84	03	81	04	87	3
4	03	15	02	46	03	13	05	12	05	08	06	50	4
5	03	94	03	08	03	91	06	40	06	34	08	12	5
6	04	73	03	69	04	69	07	68	07	61	09	75	6
7	05	52	04	31	05	47	08	96	08	88	11	37	7
8	06	30	04	93	06	25	10	24	10	15	12	99	8
9	07	09	05	54	07	32	11	52	11	42	14	62	9
10	07	88	06	16	07	81	12	80	12	69	16	24	10
11	08	66	06	77	08	59	14	08	13	95	17	87	11
12	09	45	07	39	09	38	15	36	15	23	19	49	12
13	10	24	08	00	10	16	16	64	16	50	21	12	13
14	11	03	08	62	10	94	17	92	17	77	22	74	14
15	11	82	09	23	11	72	19	20	19	03	24	37	15
16	12	60	09	85	12	50	20	48	20	30	25	99	16
17	13	39	10	46	13	28	21	76	21	57	27	62	17
18	14	18	11	08	14	06	23	04	23	84	29	24	18
19	14	97	11	69	14	84	24	32	24	11	30	87	19
20	15	76	12	31	15	63	25	60	25	38	32	49	20
21	16	55	12	93	16	41	26	88	26	65	34	12	21
22	17	34	13	54	17	19	28	16	27	92	35	74	22
23	18	13	14	16	17	97	29	44	29	19	37	36	23
24	18	92	14	77	18	75	30	72	30	46	38	98	24
25	19	70	15	39	19	52	32	00	31	73	40	61	25
26	20	49	16	00	20	31	33	28	33	00	42	23	26
27	21	28	16	62	21	09	34	56	34	27	43	86	27
28	22	06	17	23	21	88	35	84	35	54	45	48	28
29	22	85	17	85	22	66	37	12	36	81	47	11	29
30	23	64	18	47	23	44	38	40	38	07	48	73	30
31	24	43	19	08	24	22	39	68	39	33	50	35	31
32	25	22	19	69	25	00	40	96	40	60	51	97	32
33	26	00	20	31	25	78	42	24	41	87	53	60	33
34	26	79	20	93	26	56	43	52	43	14	55	22	34
35	27	58	21	54	27	34	44	80	44	41	56	85	35
36	28	37	22	16	28	13	46	08	45	68	58	47	36
37	29	16	22	77	28	91	47	36	46	95	60	10	37
38	29	94	23	39	29	69	48	64	48	22	61	72	38
39	30	73	24	00	30	47	49	92	49	49	63	35	39
40	31	52	24	63	31	25	51	20	50	76	64	97	40
41	32	31	25	24	32	02	52	48	52	02	66	60	41
42	33	10	25	86	32	81	53	76	53	29	68	22	42
43	33	88	26	48	33	59	55	04	54	56	69	85	43
44	34	67	27	09	34	38	56	32	55	83	71	47	44
45	35	46	27	70	35	16	57	60	57	10	73	10	45
46	36	25	28	32	35	94	58	88	58	37	74	72	46
47	37	04	28	94	36	72	60	16	59	64	76	35	47
48	37	82	29	55	37	50	61	44	60	91	77	97	48
49	38	61	30	17	38	28	62	72	62	18	79	60	49
50	39	40	30	78	39	06	64	00	63	45	81	21	50

Numbers	Sines Degrees 38 N.pt.	Sines Degrees 52 N.pt.	Tangents Degrees 38 N.pt.	Tangents Degrees 52 N.pts.	Secants Degrees 38 N. pt.	Secants Degrees 52 N.pts.	Numbers
51	40 19	31 40	39 84	65 28	64 72	82 84	51
52	40 98	32 01	40 63	66 56	66 00	84 46	52
53	41 76	32 63	41 41	67 84	67 27	86 09	53
54	42 55	33 24	42 19	69 12	68 54	87 71	54
55	43 34	33 86	42 97	70 40	69 81	89 34	55
56	44 13	34 47	43 75	71 68	71 07	90 96	56
57	44 92	35 09	44 52	72 96	72 33	92 59	57
58	45 70	35 70	45 31	74 24	73 60	94 21	58
59	46 49	36 32	46 09	75 52	74 87	95 84	59
60	47 28	36 94	46 88	76 80	76 14	97 46	60
61	48 07	37 55	47 66	78 08	77 41	99 09	61
62	48 86	38 17	48 44	79 36	78 68	100 71	62
63	49 64	38 78	49 22	80 64	79 95	102 34	63
64	50 43	39 40	50 00	81 92	81 22	103 96	64
65	51 22	40 02	50 78	83 20	82 49	105 59	65
66	52 01	40 64	51 56	84 48	83 76	107 21	66
67	52 80	41 25	52 34	85 76	85 02	108 83	67
68	53 58	41 87	53 13	87 04	86 29	110 45	68
69	54 37	42 48	53 91	88 32	87 56	112 08	69
70	55 16	43 10	54 69	89 60	89 83	113 70	70
71	55 95	43 71	55 47	90 88	90 10	115 33	71
72	56 74	44 33	56 25	92 16	91 37	116 95	72
73	57 52	44 95	57 02	93 44	92 64	118 58	73
74	58 31	45 56	57 81	94 72	93 91	120 20	74
75	59 10	46 18	58 59	96 00	95 18	121 82	75
76	59 98	46 79	59 38	97 28	96 45	123 44	76
77	60 68	47 41	60 16	98 56	97 72	125 07	77
78	61 46	48 03	60 94	99 84	98 99	126 69	78
79	62 25	48 65	61 72	101 16	100 26	128 32	79
80	63 04	49 26	62 50	102 40	101 52	129 94	80
81	63 83	49 88	63 28	103 68	102 80	131 58	81
82	64 62	50 49	64 06	104 96	104 06	133 20	82
83	65 40	51 10	64 84	106 24	105 32	134 82	83
84	66 19	51 71	65 63	107 52	106 59	136 44	84
85	66 98	52 33	66 41	108 80	107 87	138 07	85
86	67 77	52 95	67 19	110 08	109 13	139 69	86
87	68 56	53 56	67 98	111 36	110 40	141 32	87
88	69 34	54 18	68 77	112 64	111 67	142 94	88
89	70 13	54 79	69 55	113 92	112 94	144 57	89
90	70 92	55 41	70 32	115 20	114 21	146 19	90
91	71 71	56 03	71 11	116 48	115 48	147 82	91
92	72 50	56 65	71 89	117 76	116 75	149 44	92
93	73 28	57 26	72 68	119 04	118 01	151 07	93
94	74 07	57 88	73 46	120 32	119 28	152 69	94
95	74 86	58 49	74 24	121 60	120 55	154 31	95
96	75 65	59 10	75 02	122 88	121 82	155 93	96
97	76 44	59 71	75 80	124 16	123 09	157 56	97
98	77 22	60 33	76 58	125 44	124 36	159 18	98
99	78 01	60 95	77 36	126 72	125 63	160 81	99
100	78 80	61 57	78 13	128 00	126 90	162 43	100

Numbers	Secants Degrees 39 N. pt.	Secants Degrees 51 N. pts.
1	01 29	01 59
2	01 57	03 18
3	02 86	04 77
4	03 15	06 36
5	04 43	07 95
6	05 72	09 10
7	06 01	11 12
8	08 29	12 71
9	09 58	14 30
10	11 87	15 89
11	12 15	17 48
12	13 44	19 08
13	14 72	20 66
14	16 01	22 25
15	17 30	23 84
16	18 58	25 42
17	19 87	27 01
18	21 16	28 60
19	22 44	30 19
20	23 73	31 78
21	25 02	33 37
22	26 30	34 96
23	27 59	36 54
24	28 88	38 13
25	30 16	39 72
26	31 45	41 31
27	32 74	42 90
28	34 02	44 49
29	35 31	46 08
30	36 60	47 67
31	37 88	49 26
32	39 17	50 85
33	40 45	52 43
34	41 74	54 02
35	43 03	55 61
36	44 31	57 20
37	45 60	58 79
38	46 89	60 38
39	48 17	61 97
40	49 46	63 56
41	50 75	65 14
42	52 03	66 73
43	53 32	68 32
44	54 61	69 91
45	55 89	71 50
46	57 18	73 09
47	58 46	74 68
48	59 75	76 27
49	61 04	77 86
50	62 34	79 45

Numbers	Tangents Degrees 39 N. pt	Tangents Degrees 51 N. pt
1	00 81	01 23
2	01 62	02 47
3	02 43	03 70
4	03 24	04 94
5	04 05	06 17
6	04 86	07 41
7	05 67	08 64
8	06 48	09 88
9	07 29	11 11
10	08 10	12 35
11	08 91	13 58
12	09 72	14 82
13	10 53	16 05
14	11 34	17 29
15	12 15	18 52
16	12 96	19 76
17	13 77	20 99
18	14 58	22 23
19	15 39	23 46
20	16 20	24 70
21	17 61	25 94
22	17 52	27 17
23	18 63	28 41
24	19 44	29 64
25	20 25	30 88
26	21 05	32 11
27	21 86	33 35
28	22 67	34 58
29	23 48	35 82
30	24 29	37 05
31	25 10	38 29
32	25 91	39 52
33	26 72	40 76
34	27 53	41 99
35	28 34	43 23
36	29 15	44 46
37	29 96	45 70
38	30 77	46 94
39	31 58	48 17
40	32 39	49 40
41	33 20	50 64
42	34 01	51 88
43	34 82	53 11
44	35 63	54 35
45	36 44	55 58
46	37 25	56 82
47	38 06	58 05
48	38 87	59 29
49	39 68	60 52
50	40 49	61 75

Numbers	Sines Degrees 39 N. pt	Sines Degrees 51 N. pt.
1	00 78	00 66
2	01 55	01 26
3	02 33	01 89
4	03 11	02 52
5	03 89	03 15
6	04 60	03 78
7	05 44	04 41
8	06 22	05 03
9	06 99	05 66
10	07 77	06 29
11	08 54	06 92
12	09 32	07 55
13	10 10	08 18
14	10 88	08 81
15	11 65	09 44
16	12 43	10 07
17	13 21	10 70
18	13 99	11 33
19	14 77	11 96
20	15 54	12 59
21	16 32	13 22
22	17 10	13 85
23	17 88	14 48
24	18 65	15 11
25	19 43	15 74
26	20 21	16 37
27	20 98	17 00
28	21 77	17 63
29	22 54	18 26
30	23 32	18 88
31	24 10	19 52
32	25 88	20 15
33	25 65	20 78
34	26 43	21 41
35	27 21	22 03
36	27 68	22 66
37	28 76	23 29
38	29 53	23 92
39	30 31	24 55
40	31 09	25 17
41	31 87	25 81
42	32 64	26 04
43	33 43	27 07
44	34 20	27 70
45	34 97	28 33
46	35 75	28 96
47	36 52	29 59
48	37 30	30 22
49	38 08	30 85
50	38 86	31 47

3 Rumb and an halfe is 39 deg. 23 min.

Numbers	Sines Degrees 39 N. pt.	Sines Degrees 51 N. pt.	Tangents Degrees 39 N. pt.	Tangents Degrees 51 N. pts.	Secants Degrees 39 N. pt.	Secants Degrees 51 N. pts.	Numbers
51	39 63	32 09	41 30	62 98	65 63	81 04	51
52	40 42	32 72	42 11	64 22	66 92	82 63	52
53	41 19	33 35	42 92	65 45	68 21	84 22	53
54	41 96	33 98	43 73	66 69	69 49	85 81	54
55	42 74	34 61	44 54	67 92	70 78	87 40	55
56	43 51	35 24	45 35	69 16	72 07	88 99	56
57	44 29	35 86	46 16	70 39	73 35	90 58	57
58	45 06	36 50	46 97	71 63	74 64	92 16	58
59	45 85	37 13	47 78	72 87	75 93	93 75	59
60	46 63	37 76	48 59	74 09	77 21	95 34	60
61	47 41	38 39	49 40	75 34	78 50	96 93	61
62	48 19	39 01	50 21	76 57	79 78	98 52	62
63	48 96	39 64	51 02	77 81	81 07	100 11	63
64	49 74	40 27	51 83	79 04	82 36	101 70	64
65	50 51	40 90	52 64	80 28	83 64	103 29	65
66	51 29	41 53	53 45	81 51	84 93	104 88	66
67	52 07	42 16	54 26	82 74	86 22	106 47	67
68	52 85	42 79	55 07	83 97	87 50	108 05	68
69	53 63	43 42	55 88	85 21	88 79	109 64	69
70	54 40	44 05	56 69	86 44	90 08	111 23	70
71	55 18	44 68	57 50	87 67	91 36	112 82	71
72	55 95	45 31	58 31	88 92	92 65	114 41	72
73	56 73	45 94	59 12	90 15	93 94	116 00	73
74	57 50	46 57	59 93	91 38	95 22	117 59	74
75	58 28	47 20	60 74	92 62	96 51	119 18	75
76	59 06	47 83	61 54	93 86	97 79	120 77	76
77	59 84	48 46	62 35	95 08	99 08	122 36	77
78	60 62	49 09	63 16	96 33	100 37	123 95	78
79	61 40	49 72	63 97	97 56	101 65	125 53	79
80	62 18	50 34	64 78	98 79	102 94	127 12	80
81	62 95	50 98	65 59	100 03	104 23	128 71	81
82	63 73	51 61	66 40	101 27	105 51	130 30	82
83	64 50	52 24	67 21	102 50	106 80	131 89	83
84	65 28	52 86	68 02	103 73	108 09	133 48	84
85	66 06	53 50	68 83	104 96	109 37	135 07	85
86	66 84	54 13	69 64	106 20	110 66	136 66	86
87	67 62	54 76	70 45	107 43	111 95	138 25	87
88	68 40	55 39	71 26	108 67	113 23	139 84	88
89	69 18	56 01	72 07	109 91	114 52	141 42	89
90	69 95	56 64	72 88	111 14	115 81	143 01	90
91	70 72	57 27	73 69	112 37	117 10	144 60	91
92	71 49	57 90	74 50	113 61	118 39	146 19	92
93	72 27	58 53	75 31	114 85	119 67	147 78	93
94	73 05	59 16	76 12	116 07	120 96	149 37	94
95	73 83	59 79	76 93	117 32	122 25	150 96	95
96	74 62	60 42	77 74	118 55	123 53	152 54	96
97	75 40	61 05	78 55	119 78	124 82	154 13	97
98	76 18	61 68	79 36	121 02	126 11	155 72	98
99	76 95	62 31	80 17	122 26	127 39	157 31	99
100	77 72	62 93	80 98	123 49	128 68	158 90	100

Numbers	Sines Degrees 40 N. pt	50 N. pt	Tangents Degrees 40 N. pt	50 N. pt	Secants Degrees 40 N. pt.	50 N. pts.	Numbers
1	00 77	00 64	00 84	01 19	01 31	01 56	1
2	01 53	01 29	01 68	02 38	02 61	03 11	2
3	02 30	01 93	02 52	03 58	03 92	04 67	3
4	03 26	02 57	03 36	04 77	05 22	06 22	4
5	03 83	03 21	04 20	05 96	06 53	07 78	5
6	04 61	03 86	05 03	07 15	07 83	09 33	6
7	05 36	04 50	05 87	08 34	09 14	10 89	7
8	06 13	05 14	06 71	09 53	10 44	12 45	8
9	06 89	05 79	07 55	10 73	11 75	14 00	9
10	07 66	06 43	08 39	11 92	13 05	15 56	10
11	08 43	07 07	09 23	13 11	14 36	17 11	11
12	09 19	07 71	10 07	14 30	15 66	18 67	12
13	09 96	08 36	10 91	15 50	16 97	20 22	13
14	10 72	09 00	11 75	16 79	18 27	21 78	14
15	11 49	09 64	12 59	17 88	19 58	23 33	15
16	12 26	10 28	13 43	19 07	20 88	24 89	16
17	13 02	10 93	14 26	20 26	22 19	26 45	17
18	13 79	11 57	15 10	21 45	23 49	28 00	18
19	14 55	12 21	15 94	22 65	24 80	29 56	19
20	15 32	12 86	16 78	23 84	26 11	31 11	20
21	16 08	13 50	17 62	25 03	27 41	32 67	21
22	16 85	14 14	18 46	26 22	28 72	34 22	22
23	17 62	14 79	19 30	27 42	30 02	35 78	23
24	18 38	15 43	20 13	28 61	31 33	37 33	24
25	19 15	16 07	20 97	29 80	32 63	38 89	25
26	19 91	16 71	21 81	30 99	33 94	40 45	26
27	20 68	17 36	22 65	32 18	35 24	42 00	27
28	21 45	18 00	23 49	33 37	36 55	43 56	28
29	22 21	18 64	24 33	34 56	37 85	45 11	29
30	22 98	19 28	25 17	35 75	39 16	46 67	30
31	23 74	19 93	26 01	36 95	40 46	48 22	31
32	24 51	20 57	26 85	38 14	41 77	49 78	32
33	25 28	21 21	27 69	39 33	43 07	51 33	33
34	26 04	21 86	28 53	40 52	44 38	52 89	34
35	26 81	22 50	29 36	41 71	45 68	54 45	35
36	27 57	23 14	30 20	42 91	46 99	56 00	36
37	28 34	23 79	31 04	44 10	48 29	57 56	37
38	29 10	24 43	31 88	45 29	49 60	59 11	38
39	29 87	25 07	32 72	46 48	50 91	60 67	39
40	30 64	25 71	33 56	47 67	52 22	62 23	40
41	31 40	26 36	34 40	48 86	53 53	63 78	41
42	32 17	27 00	35 23	50 05	54 83	65 33	42
43	32 93	27 64	36 07	51 24	56 14	66 89	43
44	33 70	28 28	36 91	52 43	57 44	68 45	44
45	34 47	28 93	37 75	53 63	58 75	70 00	45
46	35 23	29 57	38 59	54 82	60 05	71 56	46
47	36 00	30 21	39 43	56 01	61 36	73 11	47
48	36 76	30 86	40 27	57 20	62 66	74 67	48
49	37 53	31 50	41 11	58 40	63 97	76 22	49
50	38 30	32 14	41 96	59 59	65 27	77 78	50

Numbers	Sines Degrees 40 N.pt.	Sines Degrees 50 N.pt.	Tangents Degrees 40 N.pt.	Tangents Degrees 50 N.pts.	Secants Degrees 40 N.pts.	Secants Degrees 50 N. pt.	Numbers
51	39 06	32 79	42 80	60 78	66° 58	79 33	51
52	39 83	33 43	43 64	61 98	67 88	80 89	52
53	40 59 60	34 07	44 48	63 17	69 19	82 45	53
54	41 36	34 71	45 32	64 36	70 49	84 00	54
55	42 13	35 36	46 15	65 55	71 86	85 56	55
56	42 89	36 00	46 99	66 74	73 10	87 11	56
57	43 66	36 64	47 83	67 93	74 41	88 67	57
58	44 43	37 28	48 67	69 12	75 71	90 22	58
59	45 19	37 93	49 51	70 31	77 02	91 78	59
60	45 96	38 57	50 35	71 50	78 32	93 34	60
61	46 72	39 21	51 19	72 70	79 63	94 89	61
62	47 49	39 86	52 02	73 89	80 93	96 45	62
63	48 26	40 50	52 86	75 08	82 24	98 00	63
64	49 02	41 14	53 70	76 27	83 54	99 56	64
65	49 79	41 79	54 54	77 46	84 85	101 11	65
66	50 55	42 43	55 38	78 65	86 15	102 67	66
67	51 32	43 07	56 22	79 85	87 46	104 22	67
68	52 08	43 71	57 06	81 04	88 76	105 78	68
69	52 86	44 36	57 90	82 23	90 07	107 33	69
70	53 62	45 00	58 74	83 42	91 38	108 90	70
71	54 38	45 64	59 58	84 62	92 68	110 45	71
72	55 15	46 28	60 42	85 81	93 99	112 00	72
73	55 91	46 93	61 25	87 00	95 29	113 56	73
74	56 68	47 57	62 09	88 19	96 60	115 11	74
75	57 41	48 21	62 93	89 38	97 90	116 67	75
76	58 25	48 86	63 77	90 57	99 21	118 22	76
77	58 98	49 50	64 61	91 76	100 51	119 78	77
78	59 74	50 14	65 45	92 95	101 82	121 33	78
79	60 51	50 77	66 30	94 15	103 12	122 89	79
80	61 28	51 42	67 13	95 34	104 43	124 46	80
81	62 04	52 07	67 76	96 53	105 73	126 01	81
82	62 81	52 71	68 80	97 72	107 04	127 57	82
83	63 57	53 36	69 64	98 91	108 34	129 12	83
84	64 34	54 00	70 48	100 10	109 65	130 68	84
85	65 10	54 64	71 32	101 30	110 49	132 24	85
86	65 87	55 28	72 16	102 49	112 26	133 79	86
87	66 64	55 93	73 00	103 68	113 57	135 34	87
88	67 40	56 57	73 84	104 87	114 88	136 90	88
89	68 17	57 21	74 68	106 07	116 18	138 46	89
90	68 94	57 45	75 52	107 26	117 49	140 01	90
91	69 70	58 50	76 36	108 45	118 79	141 57	91
92	70 47	59 14	77 20	109 64	120 10	143 12	92
93	71 23	59 79	78 03	110 83	121 40	144 68	93
94	72 00	60 43	78 87	112 02	122 71	146 23	94
95	72 76	61 07	79 71	113 22	124 01	147 79	95
96	73 53	61 71	80 55	114 41	125 32	149 34	96
97	74 30	62 36	81 39	115 60	126 62	150 90	97
98	75 06	63 00	82 23	116 79	127 93	152 46	98
99	75 83	63 64	83 07	117 98	129 23	154 01	99
100	76 60	64 28	83 91	119 17	130 54	155 57	100

Numbers	Sines Degrees 41 N. pt.		49 N. pt.		Tangents Degrees 41 N. pt		49 N. pt		Secants Degrees 41 N. pt.		49 N pts.		Numbers
1	00	75	00	66	00	87	01	15	0	22	01	52	1
2	01	51	01	31	01	74	02	30	0	65	03	05	2
3	02	26	01	97	02	61	03	45	0	97	04	57	3
4	03	02	02	62	03	48	04	60	0	30	06	10	4
5	03	77	03	28	04	35	05	75	0	62	07	62	5
6	04	53	03	94	05	22	06	90	0	95	09	15	6
7	05	28	04	59	06	09	08	05	1	27	10	67	7
8	06	04	05	25	06	95	09	20	1	60	12	19	8
9	06	79	06	90	07	82	10	35	1	92	13	72	9
10	07	55	06	56	08	69	11	50	2	25	15	24	10
11	08	30	07	21	09	56	12	65	2	57	16	77	11
12	09	06	07	87	10	43	13	80	2	90	18	29	12
13	09	81	08	52	11	30	14	95	3	22	19	82	13
14	10	57	09	18	12	17	16	10	3	55	21	34	14
15	11	32	09	84	13	04	17	25	3	87	22	87	15
16	12	08	10	49	13	91	18	40	4	20	24	39	16
17	12	83	11	15	14	78	19	55	4	52	25	92	17
18	13	59	11	80	15	65	20	70	4	85	27	44	18
19	14	34	12	46	16	52	21	85	5	17	28	97	19
20	15	09	13	12	17	39	23	01	5	50	30	48	20
21	15	85	13	78	18	26	24	16	5	82	32	02	21
22	16	61	14	43	19	03	25	31	6	15	33	54	22
23	17	36	15	09	19	90	26	46	6	47	35	07	23
24	18	11	15	75	20	77	27	61	6	80	36	59	24
25	18	87	16	40	21	64	28	76	7	12	38	12	25
26	19	63	17	06	22	51	29	91	7	45	39	64	26
27	20	38	17	71	23	38	31	06	7	77	41	17	27
28	21	13	18	37	24	25	32	21	8	10	42	69	28
29	21	89	19	03	25	12	33	36	8	42	44	21	29
30	22	64	19	68	26	08	34	51	8	75	45	73	30
31	23	40	20	33	26	95	35	66	9	07	47	26	31
32	24	15	20	99	27	82	36	81	9	40	48	79	32
33	24	91	21	65	28	69	37	96	9	72	50	31	33
34	25	65	22	30	29	56	39	11	10	05	51	84	34
35	26	42	22	96	30	43	40	26	10	37	53	36	35
36	27	17	23	61	31	30	41	41	10	70	54	89	36
37	27	93	24	27	32	17	42	56	11	02	56	41	37
38	28	68	24	93	33	04	43	71	11	35	57	94	38
39	29	44	25	58	33	91	44	86	11	67	59	46	39
40	30	19	26	24	34	77	46	02	12	00	60	97	40
41	30	96	26	89	35	64	47	17	12	32	62	50	41
42	31	70	27	55	36	51	48	32	12	65	64	03	42
43	32	46	28	20	37	38	49	47	12	97	65	55	43
44	33	21	28	86	38	25	50	62	13	30	67	08	44
45	33	98	29	51	39	12	51	77	13	62	68	60	45
46	34	72	30	17	40	09	52	92	13	95	70	13	46
47	35	48	30	83	40	86	54	07	14	27	71	65	47
48	36	24	31	48	41	73	55	22	14	60	73	18	48
49	36	99	32	14	42	60	56	37	14	92	74	70	49
50	37	74	32	80	43	47	57	52	15	25	76	22	50

Numbers	Sines Degrees 41 N.pt.	Sines Degrees 49 N.pt.	Tangents Degrees 41 N.pt.	Tangents Degrees 49 N.pts.	Secants Degrees 41 N.pts.	Secants Degrees 49 N. pt.	Numbers
51	38 50	33 46	44 33	58 67	67 57	77 74	51
52	39 25	34 12	45 20	59 82	68 90	79 26	52
53	40 01	34 78	46 07	60 97	70 22	80 79	53
54	40 76	35 43	46 94	62 12	71 55	82 31	54
55	41 52	36 09	47 81	63 27	72 87	83 84	55
56	42 27	36 75	48 68	64 42	74 20	85 36	56
57	43 03	37 40	49 55	65 57	75 52	86 89	57
58	43 78	38 08	50 42	66 72	76 85	88 41	58
59	44 54	38 71	51 29	67 87	78 17	89 94	59
60	45 28	39 37	52 16	69 02	79 50	91 46	60
61	46 05	40 03	53 02	70 17	80 83	92 98	61
62	46 80	40 68	53 89	71 32	82 15	94 50	62
63	47 56	41 33	54 76	72 47	83 47	96 03	63
64	48 31	41 99	55 63	73 62	84 80	97 55	64
65	49 07	42 65	56 50	74 77	86 12	99 08	65
66	49 82	43 30	57 37	75 92	87 45	100 60	66
67	50 58	43 96	58 24	77 08	88 77	102 13	67
68	51 33	44 61	59 11	78 23	90 10	103 65	68
69	52 08	45 27	59 98	79 38	91 42	105 18	69
70	52 84	45 93	60 85	80 53	92 75	106 70	70
71	53 60	46 58	61 71	81 68	94 07	108 22	71
72	54 35	47 24	62 58	82 83	95 40	109 74	72
73	55 10	47 89	63 45	83 98	96 72	111 26	73
74	55 86	48 55	64 32	85 13	98 05	112 79	74
75	56 62	49 20	65 19	86 38	99 37	114 31	75
76	57 37	49 86	66 06	87 43	100 70	115 84	76
77	58 12	50 51	66 93	88 58	102 02	117 36	77
78	58 88	51 17	67 80	89 73	103 35	118 89	78
79	59 63	51 83	68 67	90 88	104 67	120 41	79
80	60 39	52 49	69 54	92 03	106 00	121 94	80
81	61 14	53 15	70 41	93 18	107 32	123 46	81
82	61 90	53 80	71 28	94 33	108 65	124 98	82
83	62 64	54 46	72 15	95 48	109 97	126 50	83
84	63 41	55 12	73 02	96 63	111 30	128 03	84
85	64 16	55 87	73 89	97 78	112 62	129 55	85
86	64 93	56 43	74 76	98 93	113 95	131 08	86
87	65 67	57 09	75 63	100 08	115 27	132 60	87
88	66 43	57 75	76 50	101 22	116 60	134 13	88
89	67 18	58 40	77 37	102 38	117 92	135 65	89
90	67 93	59 05	78 24	103 54	119 25	137 19	90
91	68 69	59 71	79 10	104 69	120 57	138 71	91
92	69 45	60 37	79 97	105 84	121 90	140 23	92
93	70 20	61 03	80 84	106 99	123 22	141 75	93
94	70 96	61 68	81 71	108 14	124 55	143 27	94
95	71 71	62 33	82 58	109 39	125 87	144 80	95
96	72 47	62 99	83 45	110 44	127 20	146 32	96
97	73 22	63 65	84 32	111 59	128 52	147 85	97
98	73 98	64 30	85 19	112 74	129 85	149 37	98
99	74 73	64 96	86 06	113 89	131 17	150 90	99
100	75 47	65 61	86 93	115 04	132 50	152 43	100

3 Rumb and three quarters is 42 deg. 11 min.

Numbers	Sines Degrees 42 N. pt.	Sines Degrees 48 N. pt
1	00 74	00 67
2	01 49	01 34
3	02 23	02 01
4	02 98	02 68
5	03 72	03 35
6	04 46	04 01
7	05 20	04 68
8	05 94	05 35
9	06 69	06 02
10	07 43	06 69
11	08 18	07 36
12	08 92	08 02
13	09 66	08 69
14	10 40	09 36
15	11 14	10 04
16	11 89	10 70
17	12 63	11 37
18	13 38	12 04
19	14 12	12 71
20	14 86	13 38
21	15 60	14 05
22	16 34	14 72
23	17 09	15 39
24	17 83	16 06
25	18 58	16 73
26	19 32	17 49
27	20 06	18 07
28	20 80	18 74
29	21 54	19 40
30	22 29	20 07
31	23 03	20 74
32	23 78	21 41
33	24 52	22 08
34	25 26	22 75
35	26 00	23 41
36	26 74	24 08
37	27 49	24 75
38	28 23	25 42
39	28 98	26 09
40	29 73	26 76
41	30 47	27 42
42	31 21	28 09
43	31 95	28 76
44	32 70	29 43
45	33 44	30 10
46	34 19	30 77
47	34 93	31 44
48	35 67	32 11
49	36 41	32 78
50	37 16	33 46

Numbers	Tangents Degrees 42 N. pt	Tangents Degrees 48 N. pt
1	00 90	01 11
2	01 80	02 22
3	02 70	03 33
4	03 60	04 44
5	04 50	05 55
6	05 40	06 66
7	06 30	07 77
8	07 20	08 88
9	08 10	10 00
10	09 00	11 11
11	09 90	12 22
12	10 80	13 33
13	11 70	14 44
14	12 60	15 55
15	13 50	16 66
16	14 40	17 77
17	15 30	18 88
18	16 20	19 99
19	17 10	21 09
20	18 01	22 21
21	18 91	23 32
22	19 81	24 43
23	20 71	25 54
24	21 61	26 65
25	22 51	27 76
26	23 41	28 87
27	24 31	29 98
28	25 21	31 10
29	26 11	32 21
30	27 01	33 31
31	27 91	34 43
32	28 81	35 54
33	29 71	36 65
34	30 61	37 76
35	31 51	38 87
36	32 41	39 98
37	33 31	41 09
38	34 21	42 21
39	35 11	43 32
40	36 02	44 42
41	36 92	45 53
42	37 82	46 64
43	38 72	47 75
44	39 62	48 86
45	40 52	49 97
46	41 42	51 18
47	42 32	52 19
48	43 22	53 30
49	44 12	54 41
50	45 02	55 53

4 Rumb and a quarter is 47 deg. 49 min.

Numbers	Secants Degrees 42 N. pt.	Secants Degrees 48 N pts.
1	01 35	01 49
2	02 69	02 99
3	04 04	04 48
4	05 38	05 98
5	06 73	07 47
6	08 07	08 97
7	09 42	10 46
8	10 76	11 96
9	12 11	13 45
10	13 46	14 94
11	14 80	16 44
12	16 15	17 93
13	17 49	19 43
14	18 84	20 92
15	20 18	22 42
16	21 53	23 91
17	22 87	25 41
18	24 22	26 90
19	25 57	28 40
20	26 91	29 89
21	28 26	31 38
22	29 60	32 88
23	30 95	34 37
24	32 29	35 87
25	33 64	37 36
26	34 98	38 86
27	36 33	40 35
28	37 68	41 85
29	39 02	43 34
30	40 37	44 83
31	41 71	46 33
32	43 06	47 82
33	44 40	49 32
34	45 75	50 81
35	47 09	52 31
36	48 44	53 81
37	49 78	55 30
38	51 13	56 80
39	52 47	58 29
40	53 83	59 78
41	55 17	61 28
42	56 51	62 77
43	57 86	64 27
44	59 20	65 76
45	60 55	67 26
46	61 89	68 75
47	63 24	70 25
48	64 59	71 74
49	65 93	73 24
50	67 28	74 72

3 Rumb and three quarters is 42 deg. 11 min.

Numbers	Sines Degrees 42 N.pt.	48 N.pt.
51	37 90	34 12
52	38 64	34 79
53	39 39	35 46
54	40 13	36 13
55	40 87	36 80
56	41 61	37 47
57	42 35	38 14
58	43 08	38 81
59	43 84	39 48
60	44 59	40 15
61	45 33	40 82
62	46 07	41 49
63	46 81	42 16
64	47 55	42 83
65	48 30	43 50
66	49 04	44 17
67	49 79	44 84
68	50 53	45 50
69	51 27	46 17
70	52 02	46 84
71	52 76	47 51
72	53 51	48 18
73	54 25	48 85
74	55 00	49 52
75	55 74	50 19
76	56 49	50 86
77	57 23	51 53
78	57 98	52 20
79	58 72	52 87
80	59 45	53 53
81	60 20	54 20
82	60 94	54 87
83	61 69	55 54
84	62 43	56 21
85	63 18	56 88
86	63 92	57 55
87	64 66	58 22
88	65 40	58 89
89	66 14	59 56
90	66 88	60 22
91	67 63	60 89
92	68 38	61 56
93	69 12	62 23
94	69 86	62 90
95	70 60	63 57
96	71 34	64 24
97	72 09	64 91
98	72 83	65 58
99	73 58	66 25
100	74 31	66 91

Numbers	Tangents Degrees 42 N.pt.	48 N.pts.
45	92	56 64
46	1.82	57 75
47	2.72	58 86
48	0 62	59 97
49	52	61 08
50	42	62 19
51	1.32	63 30
52	2.22	64 41
53	12	65 52
54	01	66 64
54	92	67 75
55	2.82	68 86
56	2.72	69 97
57	62	71 08
58	52	72 19
59	43	73 30
60	1.33	74 41
61	2.23	75 52
62	2.13	76 63
63	03	77 74
63	93	78 85
64	2.83	79 96
65	2.73	81 07
66	2.63	82 18
67	53	83 29
68	43	84 40
69	2.33	85 51
70	2.23	86 62
71	2.13	87 73
72	03	88 84
72	93	89 96
73	2.83	91 07
74	2.73	92 18
75	2.63	93 29
76	53	94 40
77	43	95 51
78	2.34	96 62
79	2.24	97 73
80	14	98 84
81	04	99 95
81	94	101 06
82	2.84	102 17
83	2.74	103 28
84	2.64	104 39
85	54	105 50
86	44	106 61
87	3.34	107 72
88	3.24	108 83
89	3.14	109 94
90	04	111 05

4 Rumb and a quarter is 47 deg. 49 min.

Numbers	Secants Degrees 42 N. pt.	48 N.pts.
51	68 62	76 22
52	69 97	77 71
53	71 31	79 21
54	72 66	80 71
55	74 00	82 20
56	75 35	83 70
57	76 69	85 19
58	78 04	86 69
59	79 38	88 18
60	80 74	89 67
61	82 07	91 17
62	83 42	92 66
63	84 76	94 16
64	86 11	95 65
65	87 46	97 15
66	88 80	98 64
67	90 15	100 14
68	91 49	101 63
69	92 84	103 13
70	94 19	104 61
71	95 55	106 11
72	96 87	107 60
73	98 22	109 10
74	99 57	110 59
75	100 91	112 09
76	102 26	113 56
77	103 60	115 08
78	104 95	116 57
79	106 29	118 07
80	107 65	119 56
81	108 99	121 05
82	110 33	122 55
83	111 68	124 04
84	113 02	125 54
85	114 37	127 03
86	115 71	128 53
87	117 06	130 02
88	118 40	131 52
89	119 75	133 01
90	121 11	134 51
91	122 44	136 00
92	123 78	137 49
93	125 13	138 99
94	126 47	140 48
95	127 82	141 98
96	129 17	143 47
97	130 51	144 97
98	131 86	146 46
99	133 20	147 96
100	134 56	149 45

Numbers	Sines Degrees 43 N.pt	Sines Degrees 47 N.pt	Tangents Degrees 43 N.pt.	Tangents Degrees 47 N.pts.	Secants Degrees 43 N. pt	Secants Degrees 47 N. pts.	Numbers
1	00 73	00 68	00 93	01 07	01 27	01 47	1
2	01 46	01 36	01 86	02 14	02 55	02 93	2
3	02 19	02 05	02 80	03 22	04 10	04 40	3
4	02 93	02 73	03 73	04 29	05 47	05 87	4
5	03 66	03 41	04 66	05 36	06 84	07 33	5
6	04 39	04 09	05 60	06 43	08 20	08 80	6
7	05 12	04 77	06 53	07 51	09 57	10 26	7
8	05 85	05 46	07 46	08 58	10 94	11 73	8
9	06 58	06 14	08 39	09 65	12 31	13 20	9
10	07 31	06 82	09 33	10 72	13 67	14 66	10
11	08 04	07 50	10 26	11 79	15 04	16 13	11
12	08 78	08 18	11 19	12 87	16 41	17 60	12
13	09 51	08 87	12 12	13 94	17 77	19 06	13
14	10 24	09 55	13 05	15 01	19 14	20 53	14
15	10 97	10 23	13 99	16 08	20 51	21 99	15
16	11 70	10 91	14 92	17 16	21 88	23 46	16
17	12 43	11 59	15 85	18 23	23 24	24 93	17
18	13 16	12 28	16 79	19 30	24 61	26 39	18
19	13 90	12 96	17 72	20 37	25 98	27 86	19
20	14 63	13 64	18 65	21 45	27 35	29 33	20
21	15 36	14 32	19 59	22 52	28 71	30 80	21
22	16 09	15 01	20 52	23 59	30 08	32 26	22
23	16 82	15 69	21 45	24 66	31 45	33 73	23
24	17 55	16 37	22 38	25 74	32 81	35 20	24
25	18 28	17 06	23 32	26 81	34 18	36 66	25
26	19 01	17 74	24 25	27 88	35 55	38 14	26
27	19 75	18 42	25 18	28 95	36 92	39 60	27
28	20 48	19 10	26 11	30 03	38 28	41 06	28
29	21 21	19 78	27 04	31 10	39 65	42 53	29
30	21 94	20 46	27 98	32 17	41 02	43 99	30
31	22 67	21 14	28 91	33 24	42 39	45 46	31
32	23 40	21 82	29 84	34 31	43 75	46 92	32
33	24 13	22 50	30 78	35 39	45 12	48 39	33
34	24 86	23 18	31 71	36 46	46 49	49 86	34
35	25 59	23 87	32 64	37 53	47 86	51 32	35
36	26 32	24 55	33 58	38 61	49 22	52 79	36
37	27 05	25 23	34 51	39 68	50 59	54 25	37
38	27 79	25 91	35 44	40 75	51 96	55 72	38
39	28 52	26 59	36 37	41 82	53 33	57 19	39
40	29 25	27 28	37 30	42 89	54 69	58 65	40
41	29 98	27 96	38 24	43 97	56 06	60 12	41
42	30 71	28 64	39 17	45 04	57 43	61 59	42
43	31 44	29 32	40 10	46 11	58 79	63 01	43
44	32 17	30 01	41 03	47 18	60 16	64 52	44
45	32 91	30 69	41 97	48 26	61 53	65 98	45
46	33 64	31 37	42 91	49 33	62 90	67 45	46
47	34 37	32 06	43 83	50 40	64 26	68 92	47
48	35 10	32 74	44 77	51 47	65 63	70 38	48
49	35 83	33 42	45 70	52 54	67 00	71 85	49
50	36 57	34 10	46 63	53 62	68 37	73 31	50

Numbers	Sines Degrees 43 N.pt.	47 N.pt.	Tangents Degrees 43 N.pt.	47 N.pts.	Secants Degrees 43 N. pt.	47 N.pts.	Numbers
51	37 30	34 78	47 57	54 69	69 73	74 79	51
52	38 03	35 46	48 50	55 76	71 10	76 25	52
53	38 77	36 14	49 43	56 84	72 47	77 72	53
54	39 50	36 82	50 37	57 92	73 84	79 19	54
55	40 23	37 50	51 30	58 93	75 20	80 65	55
56	40 96	38 18	52 23	60 05	76 57	82 12	56
57	41 69	38 87	53 16	61 13	77 94	83 59	57
58	42 43	39 55	54 9	62 20	79 31	85 05	58
59	43 15	40 23	55 02	63 27	80 67	86 52	59
60	43 88	40 92	55 95	64 34	82 04	87 98	60
61	44 61	41 69	56 88	65 42	83 41	89 45	61
62	45 34	42 28	57 82	66 49	84 77	90 92	62
63	46 07	42 96	58 75	67 56	86 14	92 38	63
64	46 81	43 64	59 68	68 63	87 51	93 85	64
65	47 54	44 32	60 62	69 71	88 88	95 32	65
66	48 27	45 01	61 55	70 78	90 24	96 78	66
67	49 00	45 69	62 48	71 85	91 61	98 24	67
68	49 73	46 37	63 41	72 92	92 98	99 71	68
69	50 46	47 06	64 35	73 99	94 35	101 18	69
70	51 19	47 74	65 28	75 07	95 71	102 64	70
71	51 93	48 42	66 21	76 14	97 08	104 11	71
72	52 66	49 10	67 14	77 22	98 45	105 58	72
73	53 39	49 78	68 07	78 29	99 81	107 04	73
74	54 12	50 46	69 00	79 36	101 18	108 51	74
75	54 85	51 14	69 93	80 43	102 55	109 97	75
76	55 58	51 82	70 86	81 51	103 92	111 44	76
77	56 31	52 50	71 80	82 58	105 28	112 90	77
78	57 04	53 18	72 73	83 65	106 65	114 37	78
79	57 78	53 87	73 66	84 72	108 02	115 84	79
80	58 51	54 56	74 60	85 79	109 39	117 30	80
81	59 24	55 24	75 53	86 87	110 75	118 77	81
82	59 97	55 92	76 46	87 94	112 12	120 23	82
83	60 70	56 60	77 39	89 01	113 49	121 70	83
84	61 43	57 28	78 33	90 08	114 86	123 17	84
85	62 16	57 96	79 26	91 16	116 22	124 63	85
86	62 99	58 64	80 19	92 23	117 59	126 10	86
87	63 63	59 32	81 12	93 30	118 96	127 57	87
88	64 36	60 01	82 05	94 37	120 33	129 03	88
89	65 09	60 69	82 99	95 45	121 69	130 50	89
90	65 82	61 38	83 93	96 51	123 06	131 96	90
91	66 55	62 06	84 85	97 59	124 43	133 43	91
92	67 28	62 74	85 79	98 66	125 79	134 90	92
93	68 01	63 42	86 72	99 74	127 16	136 36	93
94	68 75	64 10	87 65	100 81	128 53	137 83	94
95	69 48	64 78	88 59	101 88	129 90	139 30	95
96	70 21	65 46	89 52	102 93	131 26	140 77	96
97	70 94	66 14	90 46	104 03	132 63	142 23	97
98	71 67	66 82	91 38	105 10	134 00	143 70	98
99	72 40	67 51	92 32	106 17	135 37	145 17	99
100	73 13	68 20	93 25	107 24	136 73	146 63	100

Numbers	Sines Degrees 44 N. pt	difference	Sines Degrees 46 N. pt	Tangents Degrees 44 N. pt.	difference	Tangents Degrees 46 N. pts.	Secants Degrees 44 N. pt	difference	Secants Degrees 46 N. pts.	Numbers
1	00 72		00 69	00 97		01 04	01 39		01 44	1
2	01 44		01 39	01 93		02 07	02 78		02 88	2
3	02 16		02 08	02 90		03 11	04 17		04 32	3
4	02 88		02 78	03 86		04 14	05 56		05 76	4
5	03 60		03 47	04 83		05 18	06 95		07 20	5
6	04 32		04 17	05 79		06 21	08 34		08 64	6
7	05 04		04 86	06 76		07 25	09 73		10 08	7
8	05 75		05 56	07 73		08 28	11 12		11 52	8
9	06 47		06 25	08 69		09 32	12 51		12 96	9
10	07 19		06 95	09 66		10 36	13 90		14 40	10
11	07 91		07 64	10 63		11 39	15 29		15 83	11
12	08 63		08 34	11 59		12 43	16 68		17 27	12
13	09 35		09 03	12 55		13 46	18 07		18 71	13
14	10 07		09 73	13 52		14 50	19 46		20 15	14
15	10 79		10 42	14 48		15 53	20 85		21 59	15
16	11 51		11 12	15 44		16 57	22 24		23 03	16
17	12 23		11 81	16 47		17 60	23 63		24 47	17
18	12 95		12 51	17 38		18 64	25 02		25 91	18
19	13 67		13 20	18 35		19 67	26 41		27 35	19
20	14 39		13 89	19 31		20 71	27 80		28 79	20
21	15 11		14 59	20 28		21 74	29 19		30 23	21
22	15 83		15 28	21 25		22 78	30 58		31 67	22
23	16 55		15 98	22 21		23 81	31 97		33 11	23
24	17 27		16 67	23 18		24 85	33 36		34 55	24
25	17 98		17 37	24 14		25 88	34 75		35 99	25
26	18 70		18 06	25 11		26 92	36 14		37 43	26
27	19 42		18 76	26 07		27 96	37 53		38 87	27
28	20 14		19 45	27 04		28 99	38 92		40 31	28
29	20 86		20 15	28 01		30 03	40 31		41 75	29
30	21 58		20 84	28 97		31 07	41 71		43 19	30
31	22 30		21 53	29 93		32 10	43 10		44 63	31
32	23 02		22 23	30 90		33 13	44 49		46 07	32
33	23 74		22 93	31 86		34 17	45 88		47 51	33
34	24 46		23 62	32 83		35 20	47 27		48 95	34
35	25 18		24 32	33 76		36 24	48 66		50 39	35
36	25 89		25 01	34 76		37 27	50 05		51 82	36
37	26 61		25 70	35 73		38 31	51 44		53 26	37
38	27 33		26 40	36 69		39 34	52 83		54 70	38
39	28 05		27 09	37 66		40 38	54 22		56 14	39
40	28 77		27 79	38 63		41 42	55 61		57 58	40
41	29 49		28 48	39 59		42 45	57 00		59 02	41
42	30 21		29 18	40 55		43 48	58 39		60 46	42
43	30 93		29 87	41 52		44 52	59 78		61 90	43
44	31 65		30 57	42 48		45 56	61 17		63 34	44
45	32 37		31 26	43 44		46 59	62 56		64 78	45
46	33 09		31 96	44 41		47 63	63 95		66 22	46
47	33 81		32 65	45 38		48 67	65 34		67 66	47
48	34 53		33 35	46 35		49 70	66 73		69 10	48
49	35 25		34 04	47 32		50 73	68 12		70 54	49
50	35 97		34 73	48 28		51 77	69 51		71 98	50

Numbers	Sines Degrees 44 N.pt.	Sines Degrees 46 N.pt.	Tangents Degrees 44 N.pt.	Tangents Degrees 46 N.pt.	Secants Degrees 44 N.pts.	Secants Degrees 46 N. pt.	Numbers
51	36 69	35 43	49 25	52 81	70 90	73 42	51
52	37 40	36 12	50 21	53 85	72 26	74 86	52
53	38 12	36 82	51 18	54 88	73 68	76 30	53
54	38 84	37 51	52 14	55 92	75 07	77 74	54
55	39 56	38 21	53 11	56 96	76 46	79 18	55
56	40 28	38 90	54 07	57 99	77 85	80 62	56
57	41 00	39 60	55 04	59 03	79 24	82 06	57
58	41 72	40 29	56 01	60 07	80 63	83 50	58
59	42 44	40 99	56 97	61 10	82 02	84 94	59
60	43 16	41 68	57 94	62 13	83 41	86 38	60
61	43 88	42 37	58 99	63 17	84 80	87 84	61
62	44 60	43 07	59 87	64 20	86 19	89 25	62
63	45 32	43 76	60 84	65 24	87 58	90 69	63
64	46 04	44 46	61 80	66 27	88 97	92 13	64
65	46 76	45 15	62 77	67 31	90 36	93 57	65
66	47 48	45 85	63 74	68 34	91 75	95 01	66
67	48 20	46 54	64 70	69 38	93 14	96 45	67
68	48 91	47 24	65 67	70 42	94 53	97 89	68
69	49 63	47 93	66 64	71 45	95 92	99 33	69
70	50 35	48 63	67 60	72 48	97 31	100 77	70
71	51 07	49 32	68 56	73 52	98 70	102 21	71
72	51 88	50 02	69 53	74 56	100 09	103 65	72
73	52 60	50 71	70 49	75 59	101 48	104 09	73
74	53 23	51 41	71 45	76 63	102 87	106 53	74
75	53 95	52 10	72 42	77 67	104 26	107 97	75
76	54 67	52 80	73 39	78 70	105 65	109 41	76
77	55 39	53 49	74 36	79 73	107 04	110 85	77
78	56 11	54 19	75 32	80 77	108 43	112 29	78
79	56 83	54 88	76 29	81 80	109 82	113 73	79
80	57 55	55 57	77 26	82 84	111 22	115 17	80
81	58 27	56 27	78 22	83 88	112 61	116 61	81
82	58 99	56 96	79 19	84 92	114 00	118 05	82
83	59 70	57 66	80 15	85 96	115 39	119 49	83
84	60 42	58 35	81 12	86 99	116 78	120 93	84
85	61 14	59 05	82 08	88 03	118 17	122 37	85
86	61 86	59 74	83 05	89 07	119 56	123 80	86
87	62 58	60 44	84 02	90 10	120 95	125 24	87
88	63 30	61 13	84 98	91 13	122 34	126 68	88
89	64 02	61 83	85 94	92 16	123 73	128 12	89
90	64 74	62 52	86 92	93 19	125 12	129 56	90
91	65 46	63 21	87 87	94 23	126 51	131 00	91
92	66 18	63 91	88 84	95 26	127 90	132 44	92
93	66 90	64 60	89 80	96 30	129 29	133 88	93
94	67 62	65 30	90 77	97 33	130 68	135 32	94
95	68 34	65 99	91 74	98 37	132 07	136 76	95
96	69 06	66 69	92 70	99 40	133 46	138 20	96
97	69 78	67 38	93 67	100 44	134 85	139 64	97
98	70 50	68 08	94 64	101 47	136 24	141 08	98
99	71 21	68 77	95 60	102 51	137 63	142 52	99
100	71 93	69 47	96 57	103 55	139 02	143 96	100

Numbers	Sines Degrees 45 N.pt	Sines Degrees 45 N.pt	Tangents Degrees 45 N.pt.	Tangents Degrees 45 N.pts.	Secants Degrees 45 N. pt	Secants Degrees 45 N. pts.	Numbers
1	00 71	00 71	01 00	01 00	01 41	01 41	1
2	01 41	01 41	02 00	02 00	02 83	02 83	2
3	02 12	02 12	03 00	03 00	04 24	04 23	3
4	02 83	02 83	04 00	04 00	05 66	05 66	4
5	03 54	03 54	05 00	05 00	07 07	07 07	5
6	04 24	04 24	06 00	06 00	08 49	08 49	6
7	04 95	04 95	07 00	07 00	09 90	09 92	7
8	05 66	05 66	08 00	08 00	11 31	11 31	8
9	06 36	06 36	09 00	09 00	12 73	12 73	9
10	07 07	07 07	10 00	10 00	14 14	14 14	10
11	07 78	07 78	11 00	11 00	15 56	15 56	11
12	08 48	08 48	12 00	12 00	16 97	16 97	12
13	09 19	09 19	13 00	13 00	18 38	18 38	13
14	09 90	09 90	14 00	14 00	19 80	19 80	14
15	10 61	10 61	15 00	15 00	21 21	21 21	15
16	11 31	11 31	16 00	16 00	22 63	22 63	16
17	12 02	12 02	17 00	17 00	24 04	24 04	17
18	12 73	12 73	18 00	18 00	25 45	25 45	18
19	13 43	13 43	19 00	19 00	26 87	26 87	19
20	14 14	14 14	20 00	20 00	28 28	28 28	20
21	14 85	14 85	21 00	21 00	29 70	29 70	21
22	15 56	15 65	22 00	22 00	31 11	31 11	22
23	16 26	16 26	23 00	23 00	32 52	32 52	23
24	16 97	16 97	24 00	24 00	33 94	33 94	24
25	17 68	17 68	25 00	25 00	35 36	35 36	25
26	18 38	18 38	26 00	26 00	36 77	36 77	26
27	19 09	19 09	27 00	27 00	38 18	38 18	27
28	19 80	19 80	28 00	28 00	39 60	39 60	28
29	20 50	20 50	29 00	29 00	41 01	41 01	29
30	21 21	21 21	30 00	30 00	42 43	42 43	30
31	21 92	21 92	31 00	31 00	43 84	43 84	31
32	22 63	22 63	32 00	32 00	45 25	45 25	32
33	23 33	23 33	33 00	33 00	46 67	46 67	33
34	24 04	24 04	34 00	34 00	48 08	48 08	34
35	24 75	24 75	35 00	35 00	49 50	49 50	35
36	25 45	25 45	36 00	36 00	50 91	50 91	36
37	26 16	26 16	37 00	37 00	52 32	52 32	37
38	26 87	26 87	38 00	38 00	53 74	53 74	38
39	27 58	27 58	39 00	39 00	55 15	55 15	39
40	28 28	28 28	40 00	40 00	56 57	56 57	40
41	28 99	28 99	41 00	41 00	57 98	57 95	41
42	29 70	29 70	42 00	42 00	59 39	59 39	42
43	30 40	30 40	43 00	43 00	60 81	60 81	43
44	31 11	31 11	44 00	44 00	62 22	62 22	44
45	31 82	31 82	45 00	45 00	63 64	63 64	45
46	32 52	32 52	46 00	46 00	65 04	65 04	46
47	33 23	33 23	47 00	47 00	66 46	66 46	47
48	33 94	33 94	48 00	48 00	67 88	67 88	48
49	34 65	34 65	49 00	49 00	69 29	69 29	49
50	35 36	35 36	50 00	50 00	70 71	70 71	50

4 Rumb is 45 degrees.

Numbers	Sines Degrees 45 N.pt.	45 N.pt.	Tangents Degrees 45 N.pts.	45 N.pts.	Secants Degrees 45 N. pt.	45 N.pts.	Numbers
51	36 05	36 06	51 00	51 00	72 12	72 12	51
52	36 77	36 77	52 1.88 00	52 1.88 00	73 53	73 53	52
53	37 47	37 47	53 1.88 00	53 1.88 00	74 35 95	74 35 95	53
54	38 18	38 18	54 00	54 00	76 37	76 37	54
55	38 89	38 89	55 00	55 00	77 78	77 78	55
56	39 60	39 60	56 00	56 00	79 19	79 19	56
57	40 30	40 30	57 2.02 00	57 2.02 00	80 61	80 61	57
58	41 01	41 01	58 00	58 00	82 02	82 02	58
59	41 72	41 72	59 00	59 00	83 48	83 48	59
60	42 43	42 43	60 00	60 00	84 85	84 85	60
61	43 13	43 13	61 00	61 00	86 26	86 26	61
62	43 84	43 84	62 2.07 00	62 2.07 00	87 68	87 68	62
63	44 54	44 54	63 00	63 00	89 09	89 09	63
64	45 25	45 25	64 00	64 00	90 51	90 51	64
65	45 96	45 96	65 00	65 00	91 92	91 92	65
66	46 67	46 67	66 00	66 00	93 33	93 33	66
67	47 38	47 38	67 2.14 00	67 2.14 00	94 75	94 75	67
68	48 08	48 08	68 00	68 00	96 16	96 16	68
69	48 79	48 79	69 00	69 00	97 58	97 58	69
70	49 50	49 50	70 00	70 00	98 99	98 99	70
71	50 20	50 20	71 00	71 00	100 40	100 40	71
72	50 91	50 91	72 2.19 00	72 2.19 00	101 82	101 82	72
73	51 62	51 62	73 00	73 00	103 22	103 22	73
74	52 32	52 32	74 00	74 00	104 65	104 65	74
75	53 03	53 03	75 00	75 00	106 06	106 06	75
76	53 74	53 74	76 00	76 00	107 48	107 48	76
77	54 44	54 44	77 2.25 00	77 2.25 00	108 89	108 89	77
78	55 15	55 15	78 00	78 00	110 30	110 30	78
79	55 86	55 86	79 00	79 00	111 72	111 72	79
80	56 57	56 57	80 00	80 00	113 14	113 14	80
81	57 27	57 24	81 00	81 00	114 55	114 55	81
82	57 98	57 98	82 2.31 00	82 2.31 00	115 96	115 96	82
83	58 69	58 69	83 00	83 00	117 37	117 37	83
84	59 39	59 39	84 00	84 00	118 79	118 79	84
85	60 10	60 10	85 00	85 00	120 20	120 20	85
86	60 81	60 81	86 00	86 00	121 62	121 62	86
87	61 52	61 52	87 2.37 00	87 2.37 00	123 03	123 03	87
88	62 22	62 22	88 00	88 00	124 44	124 44	88
89	62 93	62 93	89 00	89 00	125 86	125 86	89
90	63 64	63 64	90 00	90 00	127 28	127 28	90
91	64 35	64 35	91 00	91 00	128 69	128 69	91
92	65 05	65 05	92 2.43 00	92 2.43 00	130 10	130 10	92
93	65 76	65 76	93 00	93 00	131 51	131 51	93
94	66 46	66 46	94 00	94 00	132 93	132 93	94
95	67 17	67 17	95 00	95 00	134 35	134 35	95
96	67 88	67 88	96 00	96 00	135 76	135 76	96
97	68 59	68 59	97 2.49 00	97 2.49 00	137 17	137 17	97
98	69 29	69 29	98 00	98 00	138 55	138 59	98
99	70 00	70 00	99 00	99 00	140 00	140 00	99
100	70 71	70 71	100 00	100 00	141 42	141 42	100

4 Rumb is 45 degrees.

THE END OF THE CANON.

A Brief

CANON OF TRIANGLES, OR, The Tables OF Sines, Tangents and Secants,

in Natural Numbers: To every degree, and each ſixth minute, or tenth Centeſme of the Quadrant To the Radius of 10000.

To the which is added the differences, by which you may make them ſerve for any intermediate Minute or Centeſme.

By HENRY PHILIPPES.

LONDON

Printed by *R. & W. Leybourn*, for *George Hurlock*, and are to be ſold at his ſhop at *Magnus* Church-corner. 1657.

A Table of

M	P	Sines. 0	Sines. 90	Tangent. 0	Tangent.	Secants. 0	Secants.	P	M
0	0	0	10000	0	*Infinite*	10000	*Infinite*	100	60
06	10	17	9999	17	5729572	10000	5729581	90	54
12	20	35	9999	35	2864777	10000	2864795	80	48
18	30	52	9999	52	1909842	10000	1909868	70	42
24	40	70	9999	70	1432371	10000	1432406	60	36
30	50	87	9999	87	1145886	10000	1145930	50	30
36	60	105	9999	105	954895	10001	954947	40	24
42	70	122	9999	122	818470	10001	818531	30	18
48	80	140	9999	140	716151	10001	716220	20	12
54	90	157	9999	157	636567	10001	636646	10	06
60	100	174	9999	174	572900	10002	572987	0	0
		179	89		89		89		

Diff. 17 Diff. 17 Diff. 17

M	P	Sines. 1	Sines. 91	Tangents. 1	Tangents.	Secants. 1	Secants.	P	M
0	0	174	9998	174	572900	10002	572987	100	60
06	10	192	9998	192	520806	10002	520903	90	54
12	20	209	9998	209	477395	10002	477500	80	48
18	30	227	9997	227	440667	10003	440775	70	42
24	40	244	9997	244	409174	10003	409296	60	36
30	50	262	9997	262	381885	10003	382016	50	30
36	60	279	9996	279	358005	10004	358145	40	24
42	70	297	9996	297	336935	10004	337084	30	18
48	80	314	9995	314	318205	10005	318362	20	12
54	90	332	9995	332	301446	10006	301612	10	06
60	100	349	9994	349	286362	10006	286537	0	0
		178	88		88		88		

Diff. 17 Diff. 17 Diff. 17

A Table of

M	P	Sines. 2	Sines. 92	Tangents. 2	Tangents.	Secants. 2	Secants.	P	M
0	0	349	9994	349	286362	10006	286537	100	60
06	10	366	9993	367	272715	10007	272898	90	54
12	20	384	9993	384	260307	10007	260499	80	48
18	30	401	9992	402	248978	10008	249179	70	42
24	40	419	9991	419	238593	10009	238802	60	36
30	50	436	9990	437	229038	10009	229256	50	30
36	60	454	9990	454	220217	10010	220444	40	24
42	70	471	9989	472	212049	10011	212285	30	18
48	80	488	9988	489	204465	10012	204709	20	12
54	90	506	9987	507	197403	10013	197656	10	06
60	100	523	9986	524	190811	10014	191073	0	0
		177	87		87		87		

Diff. 17 Diff. 1 Diff. 17 Diff. 1 Diff. 17 Diff. 1

M	P	Sines. 3	Sines. 93	Tangents. 3	Tangents.	Secants. 3	Secants.	P	M
0	0	523	9986	524	190811	10014	191073	100	60
06	10	541	9985	542	184646	10015	184915	90	54
12	20	558	9984	559	178863	10016	179142	80	48
18	30	576	9983	577	173432	10017	173720	70	42
24	40	593	9982	594	168319	10018	168616	60	36
30	50	610	9981	612	163499	10019	163804	50	30
36	60	628	9980	629	158946	10020	159260	40	24
42	70	645	9979	646	154638	10021	154961	30	18
48	80	663	9978	664	150557	10022	150889	20	12
54	90	680	9977	682	146685	10023	147020	10	06
60	100	698	9976	699	143007	10024	143356	0	0
		176	86		86		86		

Diff. 18 Diff. 1 Diff. 18 Diff. 1 Diff. 18 Diff. 1

A Table of

M	P	Sines. 4	94	Tangent. 4		Secants. 4		P	M
0	0	698	9976	699	143007	10024	143356	100	60
06	10	715	9974	717	139507	10026	139865	90	54
12	20	732 Diff.	9973 Diff.	734 Diff.	136174	10027 Diff.	136541	80	48
18	30	750 17	9972 1	752 18	132996	10028 1	133371	70	42
24	40	767	9970	769	129962	10030	130346	60	36
30	50	785	9969	787	127062	10031	127455	50	30
36	60	802	9968	805	124288	10032	124690	40	24
42	70	819	9966	822	121632	10034	122043	30	18
48	80	837 17	9965 1	840 18	119087	10035 1	119510	20	12
54	90	854	9964	857	116645	10037	117073	10	06
60	100	872	9962	875	114301	10038	114737	0	0
		175	85		85		85		

M	P	Sines. 5	95	Tangents. 4		Secants. 5		P	M
0	0	872	9962	875	114302	10038	114737	100	60
06	10	889	9960	892	112048	10040	112493	90	54
12	20	906	9959	910	109882	10041	110838	80	48
18	30	924 17	9957 2	928 18	107797	10043 2	188260	70	42
24	40	941	9956	945	105789	10045	106261	60	36
30	50	958	9954	963	103854	10046	104334	50	30
36	60	976	9952	980	101988	10048	102477	40	24
42	70	993	9951	998	100187	10050	100685	30	18
48	80	1011 17	9949 2	1016 18	98448	10051 2	98955	20	12
54	90	1028	9947	1033	96768	10053	97283	10	06
60	100	1045	9945	1051	95144	10055	95668	0	0
		174	84		84		84		

A Table of

M	P	Sines. 6	Diff.	96	Diff	Tangents. 6	Diff.		Diff.	Secants. 6	Diff.		P	M
0	0	1045		9945		1051		94144		10055		95668	12	60
06	10	1063		9943		1069		93572		10057		94105	90	54
12	20	1080		9942		1086		92051		10059		92593	80	48
18	30	1097	17	9940	2	1104	18	90579	1472	10061	2	91129	70	42
24	40	1115		9938		1122		89152		10063		89711	60	36
30	50	1132		9936		1139		87769		10065		88337	50	30
36	60	1149		9934		1157		86427		10067		87004	40	24
42	70	1167		9932		1175		85126		10069		85711	30	18
48	80	1184	17	9930	2	1192	18	83863	1263	10071	2	84457	20	12
54	90	1201		9928		1210		82636		10073		83238	10	06
60	100	1219		9926		1228		81444		10075		82055	0	0
		173		83				83				83		

M	P	Sines. 7	Diff.	97	Diff	Tangents. 7	Diff.		Diff.	Secants. 7	Diff.		P	M
0	0	1219		9926		1228		81444		10075		82055	12	60
06	10	1236		9823		1246		80285		10077		80905	90	54
12	20	1253		9921		1263		79158		10079		79787	80	48
18	30	1271	17	9919	2	1281	18	78062	1096	10082	2	78700	70	42
24	40	1288		9917		1299		76996		10084		77642	60	36
30	50	1305		9914		1316		75958		10086		76613	50	30
36	60	1323		9912		1334		74947		10089		75611	40	24
42	70	1340		9910		1352		73962		10091		74635	30	18
48	80	1357	17	9907	2	1370	18	73002	960	10093	2	73684	20	12
54	90	1374		9905		1388		72066		10096		72737	10	06
60	100	1392		9903		1405		71154		10098		71853	0	0
		172		82				82				82		

A Table of

M	P	Sines. 8	98	Tangents. 8		Secants. 8		P	M
0	0	1392	9903	1405	71154	10098	71853	100	60
06	10	1409	9900	1423	70264	10101	70978	90	54
12	20	1426	9898	1441	69395	10103	70112	80	48
18	30	1444	9895	1459	68547	10106	69273	70	42
24	40	1461	9893	1477	67719	10108	68454	60	36
30	50	1478	9890	1494	66912	10111	67655	50	30
36	60	1495	9888	1512	66122	10114	66874	40	24
42	70	1513	9885	1530	65350	10116	66111	30	18
48	80	1530	9882	1548	64596	10119	65366	20	12
54	90	1547	9880	1566	63859	10122	64637	10	06
60	100	1564	9877	1584	63138	10125	63925	0	0
		171	81		81		81		

Diff. 17 3 18 2 17 3 18 2 17 3 18 2

A Table of

M	P	Sines. 10	Sines. 100	Tangents. 10	Tangents.	Secants. 10	Secants.	P	M
0	0	1737	9848	1763	56713	10154	57588	100	60
06	10	1754	9845	1781	56140	10157	57023	90	54
12	20	1771	9842	1799	55578	10161	56470	80	48
18	30	1788	9839	1817	55026	10164	55928	70	42
24	40	1805	9836	1835	54486	10167	55396	60	36
30	50	1822	9833	1853	53955	10170	44874	50	30
36	60	1840	9829	1871	53434	10174	54362	40	24
42	70	1857	9826	1890	52924	10177	53860	30	18
48	80	1874	9823	1908	52422	10180	53367	20	12
54	90	1891	9820	1926	51929	10184	52883	10	06
60	100	1908	9816	1944	51446	10187	52408	0	0
		169	79		79		79		

Diff. 17 3 — Diff. 18 — Diff. 552 — Diff. 542 — Diff. 493 — Diff. 502

M	P	Sines. 11	Sines. 101	Tangents. 11	Tangents.	Secants. 11	Secants.	P	M
0	0	1908	9816	1944	51446	10187	52408	100	60
06	10	1925	9813	1962	50970	10191	51942	90	54
12	20	1942	9810	1980	50504	10194	51484	80	48
18	30	1959	9806	1998	50045	10198	51034	70	42
24	40	1977	9803	2016	49594	10201	50593	60	36
30	50	1994	9799	2034	49162	10204	50158	50	30
36	60	2011	9796	2053	48716	10208	49732	40	24
42	70	2028	9792	2071	48288	10212	49313	30	18
48	80	2045	9789	2089	47867	10216	48901	20	12
54	90	2062	9785	2107	47453	10220	48496	10	06
60	100	2079	9782	2126	47046	10223	48094	0	0
		168	78		78		78		

Diff. 17 — Diff. 18 — Diff. 421 — Diff. 412 — Diff. 450 — Diff. 459

A Table of

M	P	Sines. 12	Diff.	Sines. 102	Diff.	Tangents.. 12	Diff.	Tangents..	Diff.	Secants. 12	Diff.	Secants.	Diff.	P	M
0	0	2079		9782		2126		47046		10223		48094		100	60
06	10	2096		9778		2144		46646		10227		47706		90	54
12	20	2113		9774		2162		46252		10231		47321		80	48
18	30	2130		9771		2180		45864		10235		46942		70	42
24	40	2147		9767		2199		45423		10239		46569		60	36
30	50	2164		9763		2217		45107		10243		46402		50	30
36	60	2181		9759		2235		44737		10247		45841		40	24
42	70	2199		9757		2254		44374		10251		45486		30	18
48	80	2216		9752		2272		44015		10255		45137		20	12
54	90	2233		9748		2290		43662		10259		44793		10	06
60	100	2250		9744		2309		43315		10263		44454		0	0
			167		77		77				77				

M	P	Sines. 13	Diff.	Sines. 103	Diff.	Tangents. 13	Diff.	Tangents.	Diff.	Secants. 13	Diff.	Secants.	Diff.	P	M
0	0	2250		9744		2309		43315		10263		44454		100	00
06	10	2267		9740		2327		42972		10267		44121		90	54
12	20	2284		9736		2346		42635		10271		43792		80	48
18	30	2301		9732		2364		42303		10276		43469		70	42
24	40	2318		9728		2382		41976		10280		43150		60	36
30	50	2335		9724		2401		41653		10284		42837		50	30
36	60	2351		9720		2419		41335		10289		42527		40	24
42	70	2368		9716		2438		41022		10293		42223		30	18
48	80	2385		9711		2456		40713		10297		41923		20	12
54	90	2402		9707		2475		40408		10302		41628		10	06
60	100	2419		9703		2493		40108		10306		41336		0	0
			166		76		76				76				

A Table of

M	P	Sines. 14	Sines. 104	Tangents. 14	Tangents.	Secants. 14	Secants.	P	M
0	0	2419	9703	2493	40108	10306	41336	100	06
06	10	2436	9699	2513	39812	10311	41048	90	54
12	20	2453	9695	2530	39520	10315	40765	80	48
18	30	2470	9690	2549	39232	10320	40486	70	42
24	40	2487	9686	2568	38947	10324	40211	60	36
30	50	2504	9682	2586	38667	10329	39939	50	30
36	60	2521	9677	2605	38391	10334	39672	40	24
42	70	2538	9673	2624	38118	10338	39408	30	18
48	80	2555	9668	2642	37848	10343	39144	20	12
54	90	2571	9664	2661	47583	10348	38890	10	06
60	100	2588	9659	2679	37321	10353	38637	0	0
		165	75		75		75		

Diff. 17 Diff. 4 Diff. 19 Diff. 288 Diff. 4 Diff. 279 Diff. 17 Diff. 5 Diff. 19 Diff. 270 Diff. 5 Diff. 261

M	P	Sines. 15	Sines. 105	Tangents. 15	Tangents.	Secants. 15	Secants.	P	M
0	0	2588	9659	2679	37321	10353	38637	100	60
06	10	2605	9655	2698	37062	10358	38387	90	54
12	20	2622	9650	2717	36806	10363	38140	80	48
18	30	2639	9646	2736	36554	10367	37897	70	42
24	40	2656	9641	2755	36305	10372	37657	60	36
30	50	2672	9636	2773	36059	10377	37420	50	30
36	60	2689	9632	2792	35816	10383	37186	40	24
42	70	2706	9627	2810	35576	10388	36955	30	18
48	80	2723	9622	2830	35339	10392	36726	20	12
54	90	2740	9617	2849	35105	10398	36502	10	06
60	100	2756	9613	2868	34874	10403	36280	0	0
		164	74		74		74		

Diff. 17 Diff. 5 Diff. 19 Diff. 252 Diff. 6 Diff. 243 Diff. 17 Diff. 5 Diff. 19 Diff. 237 Diff. 5 Diff. 229

A Table of

M	P	Sines. 16	Sines. 106	Tangents.. 16	Tangents..	Secants. 16	Secants.	P	M
0	0	2756	9613	2868	34874	10403	36280	100	60
06	10	2773	9608	2886	34646	10408	36060	90	54
12	20	2790	9603	2905	34420	10413	35844	80	48
18	30	2807	9598	2924	34197	10419	35630	70	42
24	40	2823	9593	2943	33977	10424	35418	60	36
30	50	2840	9588	2962	33759	10429	35209	50	30
36	60	2857	9583	2981	33544	10434	35003	40	24
42	70	2874	9578	3000	33332	10440	34800	30	18
48	80	2890	9573	3019	33122	10446	34598	20	12
54	90	2907	9568	3038	32914	10451	34400	10	06
60	100	2924	9563	3057	32709	10457	34203	0	0
		163	73		73		73		

Diff. 17 5 — Diff. 19 5 — Diff. 223 — Diff. 214 — Diff. 17 5 — Diff. 19 5 — Diff. 210 — Diff. 202

M	P	Sines. 17	Sines. 103	Tangents. 13	Tangents.	Secants. 17	Secants.	P	M
0	0	2924	9563	3057	32709	10457	34203	100	00
06	10	2940	9558	3076	32506	10463	34009	90	54
12	20	2957	9553	3096	32305	10468	33817	80	48
18	30	2974	9548	3115	32106	10474	33628	70	42
24	40	2990	9542	3134	31910	10480	33440	60	36
30	50	3007	5537	3152	31716	10485	33255	50	30
36	60	3024	9532	3172	31524	10491	33072	40	24
42	70	3040	9527	3191	31334	10497	32891	30	18
48	80	3057	9521	3211	31146	10503	32712	20	12
54	90	3074	9515	3230	30981	10509	32536	10	06
60	100	3090	9511	3249	30777	10515	32361	0	0
		162	72		72		72		

Diff. 17 6 — Diff. 19 6 — Diff. 196 — Diff. 189 — Diff. 17 6 — Diff. 19 6 — Diff. 188 — Diff. 179

		Sines.			Tangents.			Secants.			
M	P	18	108		18			10		P	M
0	0	3090	9511		3249	30777		10515	32361	100	60
06	10	3107	9505	Diff.	3269	30595	Diff.	10521	32188	90	54
12	20	3123	9500	Diff.	3288	30415	Diff.	10527	32017	80	48
18	30	3140	9494		3307	30237		10533	31848	70	42
24	40	3157	9489	6	3327	30061	178	10539	31681	60	36
30	50	3173	9483		3346	29887		10545	31515	50	30
36	60	3190	9478		3365	29714		10552	31352	40	24
42	70	3206	9472		3385	29544		10557	31190	30	18
48	80	3223	9467	6	3404	29375	169	10564	31030	20	12
54	90	3239	9461		3424	29208		10570	30872	10	06
60	100	3256	9455		3443	29042		10576	30716	0	0
		161	71			71			71		

		Sines.			Tangents.			Secants.			
M	P	19	109		19			19		P	
0	0	3256	9455		3443	29042		10576	30716	100	60
06	10	3272	9450		3463	28878		10583	30561	90	54
12	20	3289	9444		3482	28716		10589	30408	80	48
18	30	3305	9438	6	3502	28556	160	10596	30256	70	42
24	40	3322	9432		3522	28397		10602	30106	60	36
30	50	3338	9426		3541	28239		10609	29957	50	30
36	60	3355	9421		3561	28083		10615	29811	40	24
42	70	3371	9415		3581	27929		10622	29665	30	18
48	80	3387	9409	6	3600	27776	153	10628	29521	20	12
54	90	5404	9403		3620	27625		10635	29379	10	06
60	100	3420	9397		3640	27475		10642	29238	0	0
		160	70			70			70		

A Table of

M	P	Sines. 20	Diff.	1161	Tangents. 20	Diff.		Secants. 20	Diff.		P	M
0	0	3420		9397	3640		27475	10642		29238	100	60
06	10	3437	17	9391	3660	20	27326	10647	5	29099	90	54
12	20	3453	16	9385	3679	19	27179	10655	8	28961	80	48
18	30	3469	16	9379	3699	20	27034	10662	7	28824	70	42
24	40	3486	17	9373	3719	20	26889	10669	7	28689	60	36
30	50	3502	16	9367	3739	20	26748	10676	7	28555	50	30
36	60	3518	16	9361	3759	20	26605	10683	7	28422	40	24
42	70	3535	17	9354	3779	20	26464	10690	7	28291	30	18
48	80	3551	16	9348	3799	20	26325	10697	7	28161	20	12
54	90	3567	16	9342	3819	20	26187	10704	7	28032	10	06
60	100	3584	17	9336	3839	20	26051	10711	7	27904	0	0
			159	69			69			69		

M	P	Sines. 21	Diff.	1141	Tangents. 21	Diff.		Secants. 21	Diff.		P	M
0	0	3584		9336	3839		26051	10711		27904	100	00
06	10	3600	16	9329	3859	20	25916	10719	8	27778	90	54
12	20	3616	16	9323	3879	20	25782	10726	7	27653	80	48
18	30	3633	17	9317	3899	20	25649	10738	7	27529	70	42
24	40	3649	16	9311	3919	20	25517	10740	7	27406	60	36
30	50	3665	16	9304	3939	20	25386	10748	8	27285	50	30
36	60	3681	16	9298	3959	20	25257	10755	7	27165	40	24
42	70	3697	16	9291	3980	21	25129	10763	8	27045	30	18
48	80	3714	17	9285	4000	20	25002	10770	7	26927	20	12
54	90	3730	16	9278	4020	20	24876	10778	8	26810	10	06
60	100	3746	16	9272	4040	20	24751	10785	7	26695	00	00
			158	68			68			68		

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M	P	Sines. 22		Tangents. 22		Secants. 23		P	M
0	0	3746	9272	4049	24751	10585	26695	10	60
06	10	3762	9265	4061	24627	10793	26580	90	4
12	20	3778	9259	4081	24504	10801	26466	80	48
18	30	3795	9252	4101	24382	10808	26353	70	42
24	40	3811	9245	4122	24262	10816	26242	60	36
30	50	3827	9239	4142	24142	10824	26131	50	30
36	60	3843	9232	4163	24064	10832	26042	40	24
42	70	3859	9225	4183	23906	10840	25913	30	18
48	80	3875	9219	4204	23789	10848	25805	20	12
54	90	3891	9212	4224	23673	10856	25699	10	06
60	100	3907	9205	4245	23558	10864	25593	0	0
		157	67		67		67		

Diff. 16 7 — Diff. 20 122 — Diff. 8 112 — Diff. 8 107

M	P	Sines. 23		Tangents. 23		Secants. 23		P	M
0	0	3907	9205	4245	23558	10864	25593	100	60
06	10	3923	9198	4265	23445	10872	25488	90	54
12	20	3939	9191	4286	23332	10880	25385	80	48
18	30	3955	9185	4307	23220	10888	25282	70	42
24	40	3971	9177	4327	23109	10876	25180	60	36
30	50	3987	9171	4348	22998	10904	25078	50	30
36	60	4004	9164	4369	22889	10913	24978	40	24
42	70	4020	9157	4380	22781	10921	24879	30	18
48	80	4036	9150	4411	22673	10929	24780	20	12
54	90	4051	9143	4431	22566	10938	24683	10	06
60	100	4067	9135	4452	22460	10946	24586	0	0
		156	66		66		66		

Diff. 16 7 — Diff. 21 112 — Diff. 8 103 — Diff. 8 99

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M.	P	Sines. 24	Diff.	114	Diff.	Tangents. 24	Diff.		Diff.	Secants. 24	Diff.		Diff.	P	M
0	0	4067		9136		4452		22460		10946		24586		100	60
06	10	4083		9128		4473		22355		10955		24490		90	54
12	20	4099		9121		4494		22251		10964		24395		80	48
18	30	4115		9114		4515		22148		10972		24300		70	42
24	40	4131		9107		4536		22045		10981		24207		60	36
30	50	4147		9100		4557		21943		10990		24114		50	30
36	60	4163		9092		4578		21842		10998		24022		40	24
42	70	4179		9085		4599		21742		11007		23931		30	18
48	80	4194		9078		4621		21642		11016		23841		20	12
54	90	4210		9070		4642		21543		11025		23751		10	06
60	100	4226		9063		4663		21445		11034		23662		0	0
		155		65				65				65			

M	P	Sines. 25	Diff.	115	Diff.	Tangents. 25	Diff.		Diff.	Secants. 25	Diff.		Diff.	P	M
0	0	4226		9063		4663		21445		11034		23662		100	60
06	10	4242		9056		4684		21348		11043		23574		90	54
12	20	4258		9048		4706		21251		11052		23486		80	48
18	30	4274		9041		4727		21155		11061		23400		70	42
24	40	4289		9033		4748		21060		11070		23313		60	36
30	50	4305		9026		4770		20965		11079		23228		50	30
36	60	4321		9018		4791		20872		11089		23144		40	24
42	70	4337		9011		4813		20779		11098		23060		30	18
48	80	4352		9003		4834		20686		11107		22976		20	12
54	90	4368		8996		4856		20594		11117		22894		10	06
60	100	4384		8988		4877		20503		11126		22812		0	0
		154		54				82				82			

M	P	Sines. 26	Sines. 116	Tangent. 26	Tangent.	Secants. 26	Secants.	P	M
0	0	4834	8988	4877	20503	11126	22812	100	60
06	10	4399	8980	4899	20412	11136	22730	90	54
12	20	4415	8973	4921	20323	11145	22650	80	48
18	30	4431	8965	4942	20234	11155	22570	70	42
24	40	4438	8957	4954	20145	11164	22530	60	36
30	50	4462	8949	4986	20057	11174	22412	50	30
36	60	4478	8942	5008	19970	11184	22333	40	24
42	70	4493	8934	5030	19883	11194	22256	30	18
48	80	4509	8926	5051	19797	11204	22179	20	12
54	90	4524	8918	5073	19711	11213	22103	10	06
60	100	4540	8915	5090	19626	11223	22027	0	0
		153	63		63		63		

Diff. 16 8 — Diff. 22 89 — Diff. 9 80

Diff. 16 8 — Diff. 22 86 — Diff. 10 77

M	P	Sines. 27	Sines. 117	Tangents. 27	Tangents.	Secants. 27	Secants.	P	M
0	0	4540	8915	5090	19626	11223	22026	100	60
06	10	4555	8902	5117	19542	11233	21952	90	54
12	20	4571	8894	5139	19458	11243	21877	80	48
18	30	4587	8886	5161	19375	11253	21803	70	42
24	40	4602	8878	5184	19292	11264	21730	60	36
30	50	4618	8870	5206	19210	11274	21657	50	30
36	60	4633	8862	5228	19128	11284	21585	40	24
42	70	4648	8854	5250	19047	11294	21513	30	18
48	80	4664	8846	5272	18967	11305	21442	20	12
54	90	4679	8838	5295	18887	11315	21371	10	06
60	100	4695	8830	5317	18807	11326	21301	0	0
		152	62		62		62		

Diff. 16 8 — Diff. 22 88 — Diff. 10 74

Diff. 15 8 — Diff. 22 80 — Diff. 10 71

M	P	Sines. 28	118	Tangent. 28		Secants. 28		P	M
0	0	4695	8830	5317	18807	11326	21301	100	60
06	10	4710	8821	5340	18728	11336	21231	90	54
12	20	4725	8813	5362	18650	11347	21162	80	48
18	30	4741	8805	5384	18572	11357	21093	70	42
24	40	4756	8796	5407	18495	11368	21025	60	36
30	50	4772	8788	5430	18418	11379	21957	50	30
36	60	4787	8780	5452	18341	11390	20290	40	24
42	70	4802	8771	5475	18265	11401	20824	30	18
48	80	4817	8763	5497	18190	11411	20757	20	12
54	90	4833	8755	5520	18115	11422	20692	10	06
60	100	4848	8746	5543	18040	11434	20627	0	0
		151	61		61		61		

Diff. 15 8 — Diff. 23 78 — Diff. 11 69

M	P	Sines. 29	119	Tangents. 29		Secants. 29		P	M
0	0	4848	8746	5543	18046	11434	20627	100	60
06	10	4863	8738	5566	17966	11445	20562	90	54
12	20	4879	8729	5589	17893	11456	22498	80	48
18	30	4894	8721	5612	17820	11467	20434	70	42
24	40	2909	8712	5635	17747	11478	20371	60	36
30	50	4924	8704	5656	17645	11490	20308	50	30
36	60	4939	8695	5681	17603	11401	20245	40	24
42	70	4955	8686	5704	17532	11512	20183	30	18
48	80	4970	8678	5727	17461	11524	20122	20	12
54	90	4985	8669	5750	17390	11535	20061	10	06
60	100	5000	8660	5774	17320	11547	20000	0	0
		159	60		60		60		

Diff. 15 8 — Diff. 23 71 — Diff. 11 61

M	P	Sines. 30	120	Tangent. 30		Secants. 30		P	M
0	0	5000	8660	5774	17321	11547	20000	100	60
06	10	5015	8652	5797	17251	11559	19940	90	54
12	20	5030	8643	5820	17182	11570	19880	80	48
18	30	5045	8634	5844	17113	11582	19821	70	42
24	40	5060	8625	5867	17045	11594	19762	60	36
30	50	5075	8616	5890	16977	11606	19703	50	30
36	60	5090	8607	5914	15909	11618	19645	40	24
42	70	5105	8599	5938	16842	11630	19587	30	18
48	80	5120	8590	5961	16775	11642	19530	20	12
54	90	5135	8581	5985	16709	11654	19473	10	06
60	100	5150	8572	6009	16643	11666	19416	0	0
		149	59		59		59		

Diff. 15 9 — Diff. 24 69 — Diff. 12 57

M	P	Sines. 31	121	Tangents. 31		Secants. 31		P	M
0	0	5150	8572	6009	16643	11666	19416	100	60
06	10	5165	8563	6032	16577	11679	19360	90	54
12	20	5180	8554	6056	16512	11691	19304	80	48
18	30	5195	8545	6080	16447	11703	19249	70	42
24	40	5210	8536	6104	16383	11716	19194	60	36
30	50	5225	8526	6128	16318	11728	19139	50	30
36	60	5240	8517	6152	16255	11741	19085	40	24
42	70	5255	8508	6176	16191	11754	19030	30	18
48	80	5270	8499	6200	16128	11766	18977	20	12
54	90	5284	8490	6224	16066	11779	18924	10	06
60	100	5299	8480	6249	16003	11792	18871	0	0
		148	58		58		58		

Diff. 15 9 — Diff. 24 65 — Diff. 13 53

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M	P	Sines. 32	Diff.	122	Diff.	Tangents. 32	Diff.		Diff.	Secants. 32	Diff.		P	M
0	0	5299		8480		6249		16003		11792		18871	100	60
06	10	5314		8471		6273		15941		11805		18818	90	54
12	20	5329		8462		6297		15880		11818		18766	80	48
18	30	5344		8452		6322		15819		11831		18714	70	42
24	40	5358		8443		6346		15758		11844		18663	60	36
30	50	5373		8434		6371		15697		11857		18612	50	30
36	60	5388		8425		6395		15637		11870		18561	40	24
42	70	5402		8415		6420		15577		11883		18510	30	18
48	80	5417		8406		6445		15517		11897		18460	20	12
54	90	5432		8396		6469		15458		11910		18410	10	06
60	100	5446		8387		6494		15399		11924		18361	0	0
		147		57				57				57		

M	P	Sines. 33	Diff.	123	Diff.	Tangents. 33	Diff.		Diff.	Secants. 33	Diff.		P	M
0	0	5446		8387		6494		15399		11924		18361	100	60
06	10	5461		8377		6519		15340		11937		18312	90	54
12	20	5476		8368		6544		15282		11951		18263	80	48
18	30	5490		8358		6569		15224		11965		18214	70	42
24	40	5505		8349		6594		15166		11978		18166	60	36
30	50	5519		8339		6619		15108		11992		18118	50	30
36	60	5534		8329		6644		15051		12006		18070	40	24
42	70	5548		8319		6660		14994		12020		17023	30	18
48	80	5563		8310		6694		14938		12034		17976	20	12
54	90	5578		8300		6720		14882		12048		17929	10	06
60	100	5592		8290		6748		14826		12062		17883	0	0
		146		56				56		56				

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		Sines.		Tangents.		Secants.			
M	P	34	124	34		34		P	M
0	0	5520	8290	6745	14826	12062	17883	100	60
06	10	5606	8281	6770	14770	12076	17837	90	54
12	20	5621 Diff.	8271 Diff.	6796 Diff.	14715 Diff.	12091 Diff.	17391 Diff.	80	48
18	30	5635	8261	6822	14650	12105	17745	70	42
24	40	5656 14	8251 10	6847 25	14605 55	12119 14	17700 46	60	36
30	50	5664	8241	6873	14550	12134	17655	50	30
36	60	5678	8231	6898	14496	12149	17610	40	24
42	70	5693	8221	6924	14442	12163	17566	30	18
48	80	5707 14	8211 10	6950 26	14388 54	12178 15	17522 44	20	12
54	90	5721	8202	6976	14335	12193	17478	10	06
60	100	5736	8191	7002	14282	12208	17434	0	0
		145	55		55		55		

		Sines.		Tangents.		Secants.			
M	P	35	125	35		35		P	M
0	0	5736	8191	7002	14282	12208	17434	100	60
06	10	5750	8181	7028	14229	12223	17391	90	54
12	20	5764	8171	7054	14176	12238	17348	80	48
18	30	5789 14	8161 10	7080 26	14124 53	12253 15	17305 43	70	42
24	40	5793	8151	7107	14071	12268	17263	60	36
30	50	5807	8141	7133	14019	12283	17220	50	30
36	60	5821	8131	7159	13968	12299	17178	40	24
42	70	5835	8121	7186	13916	12314	17137	30	18
48	80	5841 14	8111 10	7212 26	13865 51	12329 15	17095 42	20	12
54	90	5864	8100	7239	13814	12345	17054	10	06
60	100	5878	8090	7265	13764	12361	17013	0	0
		144	54		54		54		

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		Sines.		Tangents.			Secants.			
M	P	36	126	36			36		P	M
0	0	5878	8090	7265	13764		12361	17013	100	60
06	10	5892	8080	7292	13713	Diff. 50	12376	16972	90	54
12	20	5906	8070	7319	13663		12392	16932	80	48
18	30	5920	8059	7346	13613		12408	16892	70	42
24	40	5934	8049	7373	13564		12424	16852	60	36
30	50	5948	8039	7400	13514		12440	16812	50	30
36	60	5962	8028	7427	13465		12456	16772	40	24
42	70	5976	8018	7454	13416		12472	16733	30	18
48	80	5990	7907	7481	13367		12489	16694	20	12
54	90	6004	7997	7508	13319		12505	16655	10	06
60	100	6018	7986	7535	13270		12521	16616	0	0
		143	53		53			53		

		Sines.		Tangents.			Secants.			
M	P	37	127	37			37		P	M
0	0	6018	7986	7535	13270		12521	16616	100	60
06	10	6032	7976	7563	13222		12538	16578	90	54
12	20	6046	7965	7590	13175		12555	16540	80	48
18	30	6060	7955	7618	13127		12571	16502	70	42
24	40	6074	7944	7646	13080		12588	16464	60	36
30	50	6088	7934	7673	13032		12605	16427	50	30
36	60	6101	7923	7701	12985		12622	16390	40	24
42	70	6115	7912	7729	12939		12639	16352	30	18
48	80	6129	7901	7757	12892		12656	16316	20	12
54	90	6143	7891	7785	12846		12673	16279	10	06
60	100	6157	7880	7813	12799		12690	16243	0	0
		142	52		52			52		

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M	P	Sines. 38	128	Tangents.. 37		Secants. 37		P	M
0	0	6157	7880	7813	12799	12690	16243	100	60
06	10	6170	7869	7841	12754	12707	16206	90	54
12	20	6184	7859	7869	12708	12725	16170	80	48
18	30	6198	7848	7898	12662	12742	16135	70	42
24	40	6212	7837	7926	12617	12760	16099	60	36
30	50	6225	7826	7954	12572	12778	16064	50	30
36	60	6239	7815	7983	12527	12796	16029	40	24
42	70	6252	7804	8012	12482	12813	15994	30	18
48	80	6266	7793	8040	12437	12831	15959	20	12
54	90	6280	7782	8069	12393	12850	15924	10	06
60	100	6293	7772	8098	12349	12868	15890	0	0
		141	51		51		51		

Diff. 14 11 29 45 18 35

M	P	Sines. 39	129	Tangents. 39		Secants. 39		P	M
0	0	6293	7772	8098	12349	12868	15890	100	00
06	10	6307	7761	8127	12305	12886	15856	90	54
12	20	6320	7749	8156	12161	12904	15822	80	48
18	30	6334	7738	8185	12218	12923	11788	70	42
24	40	6347	7727	8214	12174	12941	15755	60	36
30	50	6361	7716	8243	12131	12960	15721	50	30
36	60	6374	7705	8273	12088	12978	15688	40	24
42	70	6387	7694	8292	12045	12997	15655	30	18
48	80	6401	7683	8332	12002	13016	15622	20	12
54	90	6415	7672	8361	11960	13035	15590	10	06
60	100	6428	7660	8391	11917	13054	15557	0	0
		140	50		50		50		

Diff. 14 11 29 43 19 33

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M	P	Sines. 40	130	Tangents. 40		Secants. 40		P 100	60
0	0	6428	7660	8391	11917	13054	15557		
06	10	6441	7649	8421	11875	13073	15525	90	54
12	20	6455	7638	8451	11833	13092	15493	80	48
18	30	6468	7627	8481	11792	13112	15461	70	42
24	40	6481	7615	8511	11750	13132	15429	60	36
30	50	6494	7604	8541	11708	13151	15398	50	30
36	60	6508	7593	8571	11667	13170	15360	40	24
42	70	6521	7581	8601	11626	13190	15335	03	18
48	80	6534	7570	8632	11585	13210	15304	20	12
54	90	6547	7559	8662	11544	13230	15273	10	06
60	100	6551	7547	8693	11504	13250	15243	0	0
		139	49		49		49		

M	P	Sines. 41	131	Tangents. 41		Secants. 41		P 100	M
0	0	6561	7547	8693	11504	13250	15243		
06	10	6574	7536	8724	11463	13270	15212	90	54
12	20	6587	3524	8754	11423	13290	15182	80	48
18	30	6600	7513	8785	11383	13311	15152	70	42
24	40	6613	7501	8816	11343	13331	15122	60	36
30	50	6626	7490	8847	11303	13352	15092	50	30
36	60	6639	7478	8878	11263	13373	15061	40	24
42	70	6652	7466	8910	11224	13393	15032	30	18
48	80	6665	7455	8941	11184	13414	15003	20	12
54	90	6678	7443	8972	11145	13435	14974	10	06
60	100	6691	7431	9004	11106	13456	14945	0	0
		138	48		48		48		

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M	P	Sines. 42	132	Tangents. 42		Secants. 42		P	M
0	0	6691	7431	9004	11106	13456	14945	100	60
06	10	6704	7419	9036	11067	13477	14916	90	54
12	20	6717	7408	9067	11029	13499	14887	80	48
18	30	6730	7396	9099	10990	13520	14859	70	42
24	40	6743	7385	9131	10951	13542	14830	60	36
30	50	6756	7373	9163	10913	13563	14802	50	30
36	60	6769	7361	9195	10875	13585	14774	40	24
42	70	6782	7349	9228	10837	13607	14746	30	18
48	80	6794	7337	9260	10799	13629	14718	20	12
54	90	6807	7325	9293	10761	13651	14690	10	06
60	100	6820	7313	9325	10724	13673	14663	0	0
		137	47		47		47		

Diff. 13 12 32 36 12 28

M	P	Sines. 43	133	Tangents. 43		Secants. 43		P	M
0	0	6820	7313	9325	10724	13673	14663	100	60
06	10	6833	7302	9358	10686	13696	14635	90	54
12	20	6846	7290	9391	10649	13718	14608	80	48
18	30	6858	7278	9423	10612	13741	14581	70	42
24	40	6871	7256	9457	10575	13763	14554	60	36
30	50	6883	7254	9490	10538	13786	14527	50	30
36	60	6896	7242	9523	10501	13809	14501	40	24
42	70	6909	7230	9556	10464	13832	14474	30	18
48	80	6921	7218	9590	10428	13855	14448	20	12
54	90	6934	7205	9623	10391	13878	14422	10	06
60	100	6947	7193	9657	10355	13902	14396	0	0
		136	46		46		46		

Diff. 13 12 34 37 23 26

A Table of

		Sines.			Tangents.			Secants.			
M	P	44		134	44			44		P / 100	M
0	0	6947		7193	9657	10355		13902	14396		
05	10	6959		7181	9691	10319		13925	14370	90	54
12	20	6972	Diff.	7169	9725	10283	Diff.	13945	14344	80	48
18	30	6984		7157	9759	10247		13973	14318	70	42
24	40	6997	12	7145	9793	10212	36	13996	14293	60	36
20	50	7009		7133	9827	10176		14020	14267	50	30
36	60	7022		7120	9861	10141		14044	14242	40	24
42	70	7034		7108	9896	10105		14069	14217	30	18
48	80	7046	12	7096	9930	10070	35	14093	14192	20	12
54	90	7079		7083	9965	10035		14117	14167	10	06
60	100	7071		7071	10000	10000		14142	14142	0	0
		135		45		45			47		

A Note of good use.

ALL these kind of Tables, are never calculated farther then to the Right Angle, or 90 deg. But yet many times your Angle which you should use falls out to be an obtuse Angle, above 90 deg. in which case the ordinary rule is, to take the complement of your Angle to 180 deg. or else the complement of the excess of your Angle above 90 deg. But to ease this trouble, and to prevent mistakes herein, I have in the Table of Sines, set down the degrees for these Angles above 90 to 180 deg. the Minutes or Centesmes are to be found as for the other degrees, either upward or downward, according as the deg. stands at the top, or bottom of the Columne.

Thus the Sine of 134 deg. 18 Min. or 30 C. is 7157.

And the Sine of 135 deg. 42 Min. or 70 C. is 6984.

A Table of Meridional parts.

Degrees of Latitude.	Minutes or Sexagenary parts of a degree. 0	6	12	18	24	30	36	42	48	54	The Difference.
	Decimals, or hundred parts of a degree. 0	10	20	30	40	50	60	70	80	90	
	D. pts.	D. pts.	D. pts.	D. pts.	D. pts.	D. pts.	D. pts.	D. pts.	D. pts.	D. pts.	
0	00 000	00 100	00 200	00 300	00 400	00 500	00 600	00 700	00 800	00 900	100
1	01 000	01 100	01 200	01 300	01 400	01 500	01 600	01 700	01 800	01 900	100
2	02 000	02 100	02 200	02 300	02 400	02 500	02 601	02 701	02 801	02 901	100
3	03 001	03 101	03 201	03 301	03 402	03 502	03 602	03 702	03 803	03 903	100
4	04 003	04 103	04 204	04 304	04 404	04 504	04 605	04 705	04 805	04 906	100
5	05 006	05 106	05 207	05 307	05 408	05 508	05 609	05 709	05 810	05 910	101
6	06 011	06 111	06 212	06 312	06 413	06 514	06 614	06 715	06 816	06 916	101
7	07 017	07 118	07 219	07 319	07 420	07 521	07 622	07 723	07 824	07 925	101
8	08 026	08 127	08 228	08 329	08 430	08 531	08 632	08 733	08 834	08 936	101
9	09 037	09 138	09 239	09 341	09 442	09 543	09 645	09 746	09 848	09 949	101
10	10 051	10 151	10 254	10 355	10 457	10 559	10 661	10 762	10 864	10 966	102
11	11 068	11 17	11 27	11 374	11 476	11 578	11 680	11 782	11 884	11 986	102
12	12 088	12 190	12 293	12 395	12 497	12 600	12 702	12 805	12 907	13 010	102
13	13 112	13 215	13 318	13 421	13 523	13 626	13 729	13 832	13 935	14 038	103
14	14 141	14 244	14 347	14 450	14 553	14 656	14 760	14 863	14 967	15 070	103
15	15 174	15 277	15 381	15 485	15 588	15 692	15 796	15 900	16 004	16 107	104
16	16 211	16 316	16 420	16 524	16 628	16 732	16 836	16 941	17 045	17 150	104
17	17 255	17 359	17 464	17 568	17 673	17 778	17 883	17 988	18 093	18 198	105
18	18 303	18 408	18 513	18 619	18 724	18 830	18 935	19 041	19 146	19 251	105
19	19 356	19 463	19 569	19 675	19 781	19 887	19 993	20 100	20 206	20 312	106
20	20 419	20 525	20 632	20 738	20 845	20 952	21 059	21 165	21 272	21 379	106
21	21 486	21 593	21 701	21 808	21 915	22 023	22 130	22 238	22 345	22 453	107
22	22 561	22 669	22 777	22 885	22 993	23 101	23 210	23 318	23 427	23 535	108
23	23 643	23 752	23 861	23 970	24 079	24 188	24 297	24 406	24 515	24 624	106
24	24 734	24 8 4	24 953	25 063	25 173	25 282	25 392	25 502	25 613	25 723	110
25	25 8 3	25 943	26 054	26 164	26 275	26 386	26 497	26 608	26 719	26 830	111
26	26 941	27 052	27 164	27 275	27 387	27 499	27 610	27 722	27 838	27 946	112
27	28 058	28 171	28 283	28 396	28 508	28 621	28 734	28 847	28 959	29 072	113
28	29 186	29 299	29 423	29 526	29 640	29 753	29 867	29 981	30 095	30 209	114
29	30 324	30 438	30 553	30 667	30 782	30 897	31 112	30 127	31 242	31 357	115
30	31 473	31 588	31 704	31 820	31 936	32 052	32 168	32 284	32 409	32 517	116
31	32 633	32 750	32 867	32 984	33 101	33 218	33 336	33 453	33 571	33 688	117
32	33 806	33 924	34 042	34 161	34 279	34 397	34 516	34 635	34 754	34 873	119
33	34 992	35 111	35 231	35 350	35 470	35 590	35 710	35 830	35 950	36 071	120
34	36 191	36 312	36 433	36 554	36 675	36 796	36 917	37 039	37 161	37 283	121
35	37 405	37 527	37 649	37 771	37 894	38 017	38 140	38 263	38 386	38 509	122
36	38 633	38 757	38 880	39 004	39 129	39 253	39 377	39 502	39 627	39 752	124
37	39 877	40 002	40 128	40 253	40 379	40 505	40 631	40 757	40 884	41 011	125
38	41 137	41 264	41 392	41 519	41 646	41 774	41 902	42 030	42 158	42 287	127
39	42 415	42 544	42 673	42 802	42 931	43 061	43 191	43 320	43 451	43 581	129
40	43 711	43 842	43 973	44 104	44 235	44 366	44 498	44 630	44 762	44 894	131
41	45 026	45 159	45 292	45 425	45 558	45 691	45 825	45 959	46 093	46 227	133
42	46 362	46 496	46 631	46 766	46 902	47 037	47 173	47 309	47 445	47 581	135
43	47 718	47 855	47 992	48 129	48 267	48 404	48 542	48 681	48 819	48 958	137
44	49 097	49 236	49 375	49 515	49 655	49 795	49 935	50 076	50 217	50 [illegible]	[illegible]

A Table of Meridional parts.

Minutes or Sexagenary parts of a degree.

Degrees of Latitude.	0	6	12	18	24	30	36	42	48	54	The Difference.
	Decimals, or hundred parts of a degree.										
	0	10	20	30	40	50	60	70	80	90	
	D. pts.	D. pts.	D. pts.	D. pts.	D. pts.	D. pts.	D. pts.	D. pts.	D. pts.	D. pts.	
45	50 499	50 641	50 783	50 925	51 068	51 210	51 353	51 496	51 639	51 783	143
46	51 927	52 071	52 215	52 360	52 505	52 650	52 795	52 941	53 087	53 233	146
47	53 380	53 526	53 673	53 821	53 968	54 116	54 264	54 413	54 562	54 711	148
48	54 860	55 010	55 160	55 310	55 460	55 611	55 762	55 913	56 065	56 217	151
49	56 369	56 522	56 675	56 828	56 981	57 135	57 289	57 444	57 598	57 754	154
50	57 909	58 065	58 221	58 377	58 534	58 691	58 848	59 006	59 16	59 322	157
51	59 481	59 640	59 800	59 960	60 120	60 280	60 441	60 601	60 763	60 925	160
52	61 088	61 250	61 413	61 577	61 740	61 904	62 069	62 234	62 399	62 564	165
53	62 730	62 897	63 063	63 231	63 398	63 566	63 734	63 903	64 072	64 242	168
54	64 412	64 582	64 753	64 924	65 096	65 268	65 440	65 613	65 786	65 960	172
55	66 134	66 308	66 483	66 659	66 835	67 011	67 188	67 365	67 543	67 721	177
56	67 900	68 079	68 258	68 438	68 618	68 799	68 981	69 163	69 345	69 528	181
57	69 721	69 895	70 080	70 263	70 449	70 635	70 821	71 008	71 195	71 383	186
58	71 572	71 761	71 950	72 140	72 331	72 522	72 714	72 906	73 099	73 292	191
59	73 486	73 680	73 875	74 071	74 267	74 464	74 661	74 859	75 057	75 256	197
60	75 456	75 650	75 857	76 059	76 261	76 464	76 667	76 871	77 076	77 281	203
61	77 487	77 691	77 901	78 169	78 317	78 526	78 736	78 947	79 158	79 370	209
62	79 583	79 796	80 010	80 225	80 441	80 657	80 874	81 091	81 310	81 529	216
63	81 749	81 970	82 191	82 413	82 635	82 860	83 084	83 310	83 536	83 763	225
64	83 990	84 219	84 448	84 678	84 909	85 141	85 374	85 607	85 842	86 077	232
65	86 313	86 550	86 788	87 027	87 267	87 508	87 749	87 992	88 235	88 480	241
66	88 725	88 971	89 219	89 467	89 716	89 967	90 218	90 470	90 723	90 978	251
67	91 232	91 489	91 746	92 005	92 264	92 525	92 787	93 050	93 314	93 579	261
68	93 846	94 113	94 382	94 652	94 923	95 195	95 468	95 743	96 019	96 296	272
69	96.575	96.854	97.135	97.418	97.701	97.986	98.272	98.560	98.849	99.139	285
70	99.431	99 724	100 02	100 31	100 61	100 91	01 21	101 51	101 82	102 12	30
71	102 43	102 73	103 04	103 36	103 67	1 3 98	104 30	104 62	104 94	105 26	31
72	105 58	105 90	106 23	106 56	106 89	107 22	107 55	107 89	108 23	108 56	33
73	108 91	109 25	109 59	109 94	110 29	110 64	110 99	111 35	111 71	112 07	35
74	112 43	112 79	113 16	113 53	113 90	114 27	114 64	115 02	115 40	115 79	37
75	116 17	116 56	116 95	117 34	117 74	118 14	118 54	118 94	119 35	119 76	40
76	120 16	120 58	121 00	121 42	121 84	122 27	122 70	123 13	123 57	124 01	43
77	124 45	124 90	125 35	125 8	126 26	126 72	127 18	127 65	128 12	128 62	46
78	129 07	129 56	130 04	130 54	131 03	131 53	132 03	132 54	133 06	133 57	50
79	134 09	134 62	135 15	135 69	136 23	136 78	137 33	137 88	138 45	139 01	55
80	139 59	140 16	140 75	141 34	141 94	142 53	143 15	143 76	144 39	145 01	59
81	145 65	146 29	146 94	147 60	148 27	148 94	149 62	150 31	151 00	151 71	67
82	152 42	153 15	153 88	154 62	155 37	156 13	156 90	157 69	158 48	159 28	76
83	160 10	160 92	161 76	162 61	163 48	164 35	165 24	166 15	167 07	168 00	87
84	168 95	169 91	170 89	171 89	172 91	173 94	174 99	176 07	177 16	178 27	104
85	179 41	180 57	181 75	182 96	184 19	185 45	186 74	188 06	189 41	190 79	
86	192 21	193 66	195 16	196 68	198 25	199 87	201 53	203 24	205 00	206 83	
87	208 70	210 65	212 67	214 74	216 91	219 16	221 50	223 94	226 49	229 15	
88	231 95	234 89	239 99	241 27	244 74	248 44	252 40	256 65	261 24	266 23	
89	271 70	277 75	284 32	292 19	301 06	311 56	324 4	341 20	365 04	408 01	

Of the Table of Meridional parts.

AS I have added the Tables of *Sines*, *Tangents* and *Secants*, in natural numbers, to ſerve for the confirmation and proof of my way of working by my new *Canon*; ſo I have likewiſe added this Table of *Meridional parts*, for the farther illuſtration thereof; whereby you may not onely ſee the truth of my way of working by *Secants*, for the finding of the degrees of Longitude, but alſo the ready performance thereof.

The nature and uſe of this Table is ſo well known, that I ſhall not need to write a word about it. But this I would have you take notice of; That if you work by this Table, there is firſt as much trouble to finde out the *Meridional parts*; and then having found them, you muſt afterward frame them into a Triangle, and reſolve it by Calculation; according to this Proportion,

As the Radius,
To the difference of Latitude in Meridional parts:
So is the Tangent of the Rumb,
To the difference of Longitude.

Table of Proportion, for the differences in all the Tables.

2	3	4	5	6	7	8	9	10
2	3	4	5	6	7	8	9	10
4	6	8	10	12	14	16	18	20
6	9	12	15	18	21	24	27	30
8	12	16	20	24	28	32	36	40
10	15	20	25	30	35	40	45	50
12	18	24	30	36	42	48	54	60
14	21	28	35	42	49	56	63	70
16	24	32	40	48	56	64	72	80
18	27	36	45	54	63	72	81	90
20	30	40	50	60	70	80	90	100
22	33	44	55	66	77	88	99	110
24	36	48	60	72	84	96	108	120
26	39	52	65	78	91	104	117	130
28	42	56	70	84	98	112	126	140
30	45	60	75	90	105	120	135	150
32	48	64	80	96	112	128	144	160
34	51	68	85	102	119	136	153	170
36	54	72	90	108	126	144	162	180
38	57	76	95	114	133	152	171	190
40	60	80	100	120	140	160	180	200
42	63	84	105	126	147	168	189	210
44	66	88	110	132	154	176	198	220
46	69	92	115	138	161	184	207	230
48	72	96	120	144	168	192	216	240
50	75	100	125	150	175	200	225	250
52	78	104	130	156	182	208	234	260
54	81	108	135	162	189	216	243	270
56	84	112	140	168	196	224	252	280
58	87	116	145	174	203	232	261	290
60	90	120	150	180	210	240	270	300
62	93	124	155	186	217	248	279	310
64	96	128	160	192	224	256	288	320
66	99	132	165	198	231	264	297	330
68	102	136	170	204	238	272	306	340
70	105	140	175	210	245	280	315	350
72	108	144	180	216	252	288	324	360
74	111	148	185	222	259	296	333	370
76	114	152	190	228	266	304	342	380
78	117	156	195	234	273	312	351	390
80	120	160	200	240	280	320	360	400
82	123	164	205	246	287	328	369	410
84	126	168	210	252	294	336	378	420
86	129	172	215	258	301	344	387	430
88	132	176	220	264	308	352	396	440
90	135	180	225	270	315	360	405	450
92	138	184	230	276	322	368	414	460
94	141	188	235	282	329	376	423	470
96	144	192	240	288	336	384	432	480
98	147	196	245	294	343	392	441	490
100	150	200	250	300	350	400	450	500
2	3	4	5	6	7	8	9	10

1	2	3	4	5	6	7	8	9	10
51	102	153	204	255	306	357	408	459	510
52	104	156	208	260	312	364	416	468	520
53	106	159	212	265	318	371	424	477	530
54	108	162	216	270	324	378	432	486	540
55	110	165	220	275	330	385	440	495	550
56	112	168	224	280	336	392	448	504	560
57	114	171	228	285	342	399	456	513	570
58	116	174	232	290	348	406	464	522	580
59	118	177	236	295	354	413	472	531	590
60	120	180	240	300	360	420	480	540	600
61	122	183	244	305	366	427	488	549	610
62	124	186	248	310	372	434	496	558	620
63	126	189	252	315	378	441	504	567	630
64	128	192	256	320	384	448	512	576	640
65	130	195	260	325	390	455	520	585	650
66	132	198	264	330	396	462	528	594	660
67	134	201	268	335	402	469	536	603	670
68	136	204	272	340	408	476	544	612	680
69	138	207	276	345	414	483	552	621	690
70	140	210	280	350	420	490	560	630	700
71	142	213	284	355	426	497	568	639	710
72	144	216	288	360	432	504	576	648	720
73	146	219	292	365	438	511	584	657	730
74	148	222	296	370	444	518	592	666	740
75	150	225	300	375	450	525	600	675	750
76	152	228	304	380	456	532	608	684	760
77	154	231	308	385	462	539	616	693	770
78	156	234	312	390	468	546	624	702	780
79	158	237	316	395	474	553	632	711	790
80	160	240	320	400	480	560	640	720	800
81	162	243	324	405	486	567	648	729	810
82	164	246	328	410	492	574	656	738	820
83	166	249	332	415	498	581	664	747	830
84	168	252	336	420	504	588	672	756	840
85	170	255	340	425	510	595	680	765	850
86	172	258	344	430	516	602	688	774	860
87	174	261	348	435	522	609	696	783	870
88	176	264	352	440	528	616	704	792	880
89	178	267	356	445	534	623	712	801	890
90	180	270	360	450	540	630	720	810	900
91	182	273	364	455	546	637	728	819	910
92	184	276	368	460	552	644	736	828	920
93	186	279	372	465	558	651	744	837	930
94	188	282	376	470	564	658	752	846	940
95	190	285	380	475	570	665	760	855	950
96	192	288	384	480	576	672	768	864	960
97	194	291	388	485	582	679	776	873	970
98	196	294	392	490	588	686	784	882	980
99	198	297	396	495	594	693	792	891	990
100	200	300	400	500	600	700	800	900	1000
1	2	3	4	5	6	7	8	9	1

The Uſe of this Table of Proportion.

THe uſe I ſhall make of this Table here, is to finde the part proportional for any Decimal, or centeſm part of a degree, by the difference which is ſet down in theſe Tables between each degree. And here the queſtion or the caſe is twofold: either by the difference to finde the part proportional for any part of that degree, or elſe by the difference and the part proportional allotted, to finde the part of the degree anſwering thereunto.

The firſt Caſe to finde the proportional part for any part of a degree.

For the firſt, knowing the difference, and the part of the degree, to finde the part proportional thereof. This may eaſily be done by Multiplication, but more readily by this Table; for here finde but the whole difference in the firſt colum, and the other columns ſhew the part proportional for every tenth part of the degree, if the ſaid difference be not more then 100 parts, onely you muſt ſeparate the laſt figure from the other by a (.) for a fraction.

Thus the difference between any degree being 65 parts, the part proportional for each Decimal or tenth part of that degree will be as in the Table, in the line againſt 65. *viz.*

1	2	3	4	5	6	7	8	9	10
6.5	13.0	19.5	26.0	32.5	39.0	45.5	52.0	58.5	65.0

If you would have the part proportional for each centeſm of a degree; firſt, ſet down for the Decimal part, as before, and afterwards for the centeſm part; and ſo adding them together, and cutting off the two laſt figures, as a fraction, you ſhall have the part proportional thereof.

Thus,

Thus the difference being 65, as before, the proportional parts will be thus:

11	22	33	44	55	66	77	88	99
65	130	195	260	375	390	455	520	585
65	130	195	260	375	390	455	520	585
7.15	14.30	21.45	28.60	41.25	42.90	50.05	57.20	64.35

If the difference of your whole degree be above 100 parts, seek the neerest number in the last column, and take that line for your decimal parts, as before, so the errour will not be much. Thus your difference being 655, you may take either the line 650, or 660, without any great danger of errour, if you work onely in Decimal parts: but if you will be more exact, take first the part proportional for the two first figures thereof, and afterwards for the other figure, you may finde the centesm thereof the long wayes of the Table, which fitly placed under the other, and added together, shews the true part proportional.

Thus first for 650, and then for 005, the proportional part is thus:

11	22	33	44	55	66	77	88	99
65	130	195	260	325	390	455	520	585
65	130	195	260	325	390	455	520	585
55	110	165	220	275	330	385	440	495
72.05	144.10	216.15	288.20	360.25	432.30	504.35	576.40	648.45

If you think this too much trouble, you may content your self, as I said before with the Decimal part, which may more easily be had, and is exact enough in most cases. But this is as soon and sooner performed, then the ordinary way by the Rule of proportion, *viz.*

As the whole degree or 100 parts,	100	655
To the whole difference	655	99
So any centesm part of a degree	99	5895
To the part proportional thereof	648.45	5895
		648.45

The second case is thus: when you know the difference of the whole degree, and also the part proportional is known or alotted, to finde thereby, to what centesm of the degree it answers. This is to be done by the converse of the former Rule, wherein you must work by Division, as before by Multiplication.

For as the whole difference	650
To one degree, or 100 parts	100
So the part of the difference alotted	585
To the centesm part of the degree	90

In this the Table will help you as much as in the former; for finde your difference 650 in the last column of the Table, and look along in that line, till you finde your part proportional, or the neerest to it, which here is 585; this you shall finde in the ninth column of the Table, therefore the part of the degree answering hereunto is either 9 tenths or 90 centesms of a degree.

If this Table were inlarged, it would do this businesse somewhat more exactly and readily, when you work in centesmes of a degree. But as for decimal parts (vvhich are as exact as you need) this part of the Table vvill do as vvell as all of it, thongh this Table would be of great use in Arithmetick, and much might be said thereof, yet I shall not inlarge upon it at present, but leave you sometimes to exercise your Multiplication and Divisions.

THE ADVANCEMENT OF THE ART OF NAVIGATION.

The Second Part.

SHEWING

Several wayes for the regulating of the Log-line; for the more exact finding of the true way of a Ship thereby.

WITH

Several other Instruments and conclusions propounded for this purpose; whereby the Minutes and Seconds of time may be exactly distinguished; and the constant motion of a Ship more certainly known; then by any other way used heretofore.

By HENRY PHILIPPES.

LONDON

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THE
ADVANCEMENT
OF
THE ART
OF
NAVIGATION.

THE ADVANCEMENT OF THE ART OF NAVIGATION.

The Second Part.

IN the Practice of the Art of Navigation there is no one thing more necessary, then to be able to make a true estimate of the way which the ship makes with any wind, according to the strength and continuance thereof, for this is one thing must still be known, by what Chart soever you you keep the account.

The best way in use for this purpose, is by the Log-line, and a minute glasse, which though it be well known, and of good and ancient use among Sea-men; yet there are many things as to the manner of using thereof, worthy consideration, which are not taken notice of by Sea-men,

which would much help them in the true knowledge of their ſhips motion; And to this purpoſe I ſhall propound, firſt, ſome things concerning the true length of the Log-line, and the ordinary uſe thereof by a minute glaſſe; after the old way. Secondly, I ſhall propound ſomewhat concerning the exact meaſuring of the time without a glaſſe, more exactly then by a glaſſe, ſo that you ſhall not onely know the firſt minutes of time, but the ſeconds, and half ſeconds thereof by a moſt plain and eaſie concluſion as you can deſire, and accordingly ſhall ſhew you how you ſhall uſe the Log-line, after ſomewhat a different and a better way. Thirdly, I ſhall propound unto you ſome Inſtruments or Engines, which with a little coſt and care may be brought to perfection; ſo that they ſhall ſhew the ſhips way much better then the Log line, or any other way hitherto publiſhed.

To divide the Log-line to ſhew the 100. part of a degree.

For the firſt of theſe particulars. That which I would adviſe you about the length of the Log-line is this; That you make a knot at every 30 feet length of your line, and obſerve the running thereof by an halfe minute glaſſe, for then ſo many knots as veer out in halfe a minute, ſo many 100 parts of a degree the ſhip runs in an hour. So that hereby you may readily account your ſhips way in degrees and hundred parts (which is beſt and moſt agreeable to theſe Maps, and ſo for any other number of hours, or for a day or two, as long as you ſee that force of wind and motion laſteth.

To mark the Log-line to ſhew the Miles or Minutes of a degree.

Or elſe if you have a mind to know the way of the ſhip in miles and leagues, or rather in minutes or 60 parts of a degree, then becauſe there is in one whole degree 360000 feet, there will be in every minute or 60 part thereof 600 feet. And therefore if you make a knot at every 50 feet length of your line, and uſe an halfe minute glaſſe; obſerve how many knots run out in half a minute, and ſo many miles or minutes doth the ſhip run every hour, and every 5 feet more, ſhews the tenth part of a mile over.

Either of these wayes you will find much more exact then the old rule, of making a knot at every 42 feet or seven fathoms, which is grounded upon this erroneous principle, that there is onely 300000 feet in a degree, and so but 5000 feet in a minute or mile. It being proved by Mr. *Norwoods* experiment that there is about 367200 feet in a degree, though for the better conveniency of the divisions of the numbers and the line, and other good causes he takes but 360 00 feet into the degree.

1
3
3
12
36

Now though this be the best way in use to finde out the dead reckoning: yet some that would be accounted old experienced Sea-men think they can guesse well enough of the way the ship makes though they seldome or never use the Log-line It is true, experience may give a good guesse hereat: but to be the more sure, it is good to use all helps, and yet all little enough sometime. Others they use to make some marks along the ships sides at a certaine number of feet, and so letting any thing fall into the water at the head of the ship, observe in what time it passeth by those marks, and so judge of the ships way. This way is subject to many exceptions, as first the dead water which the ship makes at her sides, causeth the motion of the thing that swimmes by to be too slow. Secondly, the shortnesse of the measure of this motion, which can be but the ships length which is seldom an 100 feet. Thirdly, the shortnesse of the time of this motion, and the difficulty to know it exactly, yet because this way is better then none, and also because I shall shew you a good way for the true measuring not onely of minutes but seconds of time, I shall shew you how to place marks on your ship sides, whereby you may know the way your ship makes.

It is good for all to make use of the Log-line, or some other way.

If you will reckon the ships way in miles or 60 parts of a degree, then measure 50 feet length upon the side of your ship and place two marks there: and if the ship run the distance of these two marks in halfe a minute or 30 seconds,

To make two marks on the ship sides, to shew the way in minutes.

conds, it is after the rate of one mile an hour. If the ſhip run theſe 50 feet in a quarter of a minute or 15 ſeconds it is two miles an hour. If it run this diſtance in 10 ſeconds it is 3 miles an hour. If it run this diſtance in 6 ſeconds it is 5 miles an hour. If it run this diſtance in 5 ſeconds it is 6 miles an hour. If in 3 ſeconds it is 10 miles an hour.

Another way by many ſhort marks.

Or elſe if you make a row of marks along your ſhip ſide, making a mark at every twenty inches, then if your ſhip run on of theſe marks in a ſecond, it is one mile an hour. If the ſhip run two of theſe parts in a ſecond, it is two miles an hour: if three, it is three miles, if 5 it is five miles, &c. Or elſe if you divide the number of parts the ſhip runs, by the ſeconds of time, it ſhews how many miles the ſhip runs in an hour. Thus if the ſhip run 20 of theſe parts in 5 ſeconds, it is 4 miles an hour: if 20 in 4 ſeconds it is 5 miles an hour: if 20 in 2 ſeconds it is 5 miles an hour.

To make two marks on the ſhip ſides to ſhew the way in 100 parts.

In like manner if you would reckon your ſhips way in hundred parts of a degree, then make your marks at 30 foot diſtance upon your ſhips ſides, and if your ſhip long enough you may make two or three of theſe marks 30 foot aſunder. So if your ſhip run one of theſe diſtances in halfe a minute, it is one 100 part of a degree in an hour: if 2 of them, it is 200 parts, &c. Or elſe if it run one of theſe diſtances in 30 ſeconds or halfe a minute, it is 100 parts of a degree an hour; if one in 15 ſeconds it is 200 parts an hour, if one in 10 ſeconds it is 300 parts an hour, and ſo alwayes divide the halfe minute or 30 ſeconds, by the number of the marks of the ſhips motion, and the quotient ſhews the 100 parts of a degree run in the hour.

To find the ſame by many ſhort marks.

Laſtly, if you make marks at every foot upon the ſhip ſides, then if the ſhip move one foot in a ſecond of time, it is 100 parts an hour; if 2 feet or marks, it is 200 parts; if 5 feet or marks in a ſecond of time, it is 500 parts an hour. Or as before divide the number of theſe feet or parts run, by the ſeconds of time, and the quotient ſhews the number of 100 parts, which the ſhip runs in an hour.

The

The Second general head concerning the meaſuring of the time.

If you will know the true quantity of your ſhips way, you muſt not onely be careſull in dividing your line, but you muſt alſo be very exact in meaſuring the time: and not content your ſelfe as ſome do, to eſtimate the time by the pronouncing of a few words, or telling a certaine number. As ſome think the ſaying of the Lords prayer, others that the telling of twice three ſcore will take up a minute of time. But theſe wayes are not onely uncertaine in reſpect of ſeveral men, ſome ſpeaking ſlower, and ſome faſter: but it will be an hard thing for one, and the ſame man not to be ready to tell faſter or ſlower, as he ſhall ſee the motion of any thing by him to be ſwifter or ſlower. Beſides a man may readily, and ſo be more apt to tell 1, 2, 3, 4, 5, &c. to ten or twenty, faſter then 21, 22, &c. there being more time required to pronounce theſe double numbers, though his fancy may helpe him, if not other wayes imployed.

Several uncertaine ways which many uſe to eſteemate the time of a minute by.

Kepler obſerves that the pulſe of a ſtrong healthfull man beats about 4000 ſtrokes in an hour: which is 67 times in a minute. But Elderly and Melancholy mens pulſes beat ſlower, about 60 times in a minute, whereas hot cholerick conſtitutions their pulſes beat 80 times in a hour, neither doth a mans pulſe beat all times alike, ſo that this is but an uncertaiue rule.

It is ſomewhat a better way to meaſure theſe ſmall moments of time by walking a certaine number of ſteps or ſtrides. Thus a man walking a good handſome pace, *viz.* after the rate of 3 Engliſh meaſured miles, or two and an half of ordinary country miles an hour, doth take 120, or twice three ſcore ſteps in a minute of an hour, which is two ſteps in every ſecond. For thus the head and foot being both in action, the motion of the feet being alwayes equal, will keep the tongue from running to faſt in thoſe leſſer

leſſer ſingle numbers, and ſo the more ſenſes being excerciſed about this, they will one help the other.

But the beſt way hitherto uſed for this purpoſe is a good glaſſe made to runne a juſt minute, or halfe a minute or 36 minutes which is the hundreth part of an hour, according as you pleaſe your leſſe, and as your line is fitted with knots. Againſt this if it be well and truly made, I have little or nothing to except: But yet theſe glaſſes ſhew onely the time they run for, whether it be a minute or half a minute, and give no good notice of the ſeconds or ſmaller moments of the time, which may in many caſes be of good uſe, as I ſhall give ſome inſtances anon.

And becauſe you cannot be too carefull in meaſuring theſe ſmall parcels of time, ſince a ſmall error in a minutes time will come to much in 60 minutes which is but one hour, and much more in a day or a longer time: therefore I ſhall ſhew you two or three wayes, which may eaſily be brought into uſe, which will be very exact for the meaſuring not only of thoſe minutes, but alſo of their ſeconds.

To find the time of a minute by a watch or clock.

The firſt way may be by a watch or clock, either a ſmall pocket watch, or thoſe greater or leſſer braſſe clocks, which goe by weights, either of theſe may be ſo contrived by a good workman, that they may by little hands or Indices ſhew the minutes and ſeconds, as well as the hours, and ſome ſuch I have ſeen made, and the like may be eaſily performed in others. For generally the ballance wheele of a great braſſe clock, which goes by weights turns about in a minute of an hour: And ſome of their leſſer ſize their ballance wheel turns about twice in an hour. But becauſe th s wheel goes as it were by ſteps and ſtarts, it will much better be performed in a pocket watch, if the contrite wheel be fitted ſo as to turn about in a minute, this may have a little Index and circle fitted to it, which will ſhew the ſeconds very handſomely and truly.

But if you think this may be too chargeable to have watches made on purpoſe, you may do the like by any ordinary

dinary watch, if you beſtow the reckoning of the teeth of the wheels, and ſo finde how they are moved one by another. Thus in an ordinary watch which hath four wheels, and the pinions 5 leaves or teeth. There is firſt the ballance wheel, whoſe pinion hath 5 leaves; this is turned by the cantrite or crown vvheel, vvhich hath 40 teeth, ſo that if you divide 40 by 5, you ſhall finde this wheel at each turning turns the ballance vvheel 8 times about. Then there is the ſecond wheel, vvhich hath 45 teeth: this therefore turns about the crown vvheel 9 times. Laſtly, there is the great vvheel, and this hath 55 teeth, ſo that this turns about the ſecond vvheel 11 times. Now if you multiply theſe one the other:

The ballance wheel	1	
The Cantrite wheel turns this 8 times	8	
The ſecond wheel turns the Cantrite 9 times.	9	times.
Which being multiplyed together, is	72	
The great wheel turns this 11 times	11	
By which multiply the other, it makes	792	

So that the great wheel by once turning about, turns about the ballance-wheel 792 times.

Now this great wheel uſually hath a pinion of 4, and the hour-wheel hath 36 teeth; ſo that it turnes about 9 times in 12 hours, and ſo brings the hand of the watch round about, in which 12 hours there are 720 min. which divided by 9, ſhews this great wheel turns about juſt in 80 minutes: divide therefore the foreſaid 792 turnes of the ballance wheel by theſe 80 minutes of time, and you ſhall finde 9. 90. ſo that the ballance wheel turns about 9 times, and 90 hundred parts in a minute of an hour.

But this coming ſo neer to 10 times, you may account 10 turns of the ballance wheel to a minute, and ſo every turn of the ballance-wheel is 6 ſeconds.

But it being too troublesome to stand poreing upon the swift motion of the ballance wheel, and so to keep count of the ten revolutions; you see before that the cantrite wheel turns the ballance-wheel 8 times about, so that this cantrite wheel is 8 times 6 seconds, or 48 seconds in turning about. Therefore if you make a mark upon the ballance wheel, and another upon the cantrite wheel, you shall know that when these marks comes to a certain place together, that the ballance wheel is turned about 8 times, and then twice more makes up the minute.

Or else, if you set first one mark upon the cantrite wheel, and then set two other marks by it; the one ten teeth before it, and the other ten teeth after it; the one of these will shew six bouts of the ballance wheel, which is 36 minutes, which is the 100 part of an hour, and the latter will shew the minute, or 60 part of an hour.

In these conclusions it will be best to mark both the ballance wheel, and the cantrite wheel, (which you may do, when your watch is in pieces with a little graver, or if you please with your pen, and a little ink) for both wheels being thus marked, the mark upon the ballance wheel coming to your eye will more exactly shew the true revolution of either wheel, and the marks upon the other will give you better notice of the number of the bouts of the ballance wheel, and when the minute is up.

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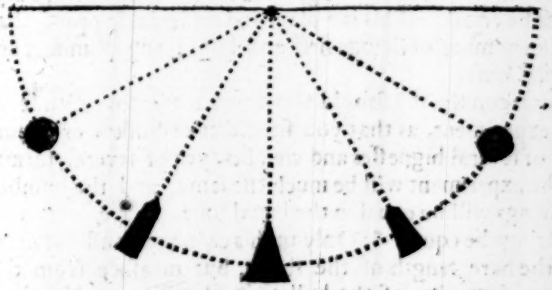
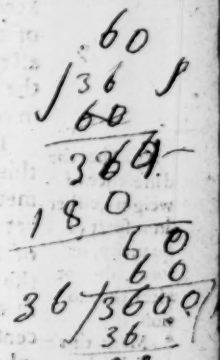
To conclude this conclusion, though all watches are not made with these numbers of teeth, but some have six leaves in a pinion, and some difference also may be in the number of the teeth of the wheeles, yet you may by this Example know how to find out the like by any other watch and so by two marks upon the cantrite and ballance wheel, finde the true time of a minute, or half a minute, or 36 seconds, which is the hundred part of an hour, or any other small proportion of time you desire.

But the moſt eaſie and exact way for the meaſuring of theſe ſmall parcels of time, is by hanging a good big bullet or a plummet in a ſtring, the ſtring being fitted to a juſt length, and fixed handſomely to the top of any Room, or any timber of the ſhip; and ſo telling the ſwings thereof. And this will prove no * childiſh concluſion, as it may ſeem at the firſt, but may be made good uſe of in many things, and will be moſt eaſie and exact in the performance, if you conſider theſe experiments about it.

A new experiment by the ſwinging of a plummet, to know any ſmall part of time exactly.

* See *Galileus* his Dialogues, and *Digby*, of Bodies.





Firſt, it may be proved by demonſtration, but more eaſily by experience, that a bullet or plummet hung in a ſtring, and being moved gently from the perpendicular to any angle, (keeping the ſtring ſtraight) and ſo let go to have its own ſwing, will keep ſuch exact time in its ſwinging, that though it fetcheth a greater compaſſe at the firſt ſwinging thereof, yet it keeps the ſame time in the ſame number of ſwings. So that if it make 30, 40, or 60 ſwings in a minute at the firſt motion, it will do the like afterward, until it ſtands quite ſtill. And if you will have an eaſie experiment to prove this; take two bullets of like weight, and let them hang in the ſtrings of like length, let theſe two bullets be drawn from their perpendiculars to an equal angle, and both

Firſt thing obſeruable in this. The ſame number of ſwings firſt and laſt are made in the ſame ſpace of time.

let go together, you ſhall finde them keep the ſame time and motion together for a long time, if the ſtrings be juſt of equal length.

An eaſie proof that the ſwings keep equal time.

But now to try whether they keep the ſame time alſo of their firſt and laſt motion, do thus. When the one of them hath ſwong a good while, then lift up the other to a convenient height, ſo as the firſt was before, and ſo let it go of it ſelf; and though this plummet laſt let fall will fetch a greater compaſſe then the other, yet you ſhall finde them keep a juſt number in their ſwings, ſo that the one ſhall get of the other little or nothing, if the length of the ſtrings and all elſe be equal. This is a plain and undeniable proof, that the like number of ſwings firſt and laſt of any plummet are in equal time.

2ly. That the difference of weights, either in reſpect of quantity, or form, do not alter the motion.

* Mark this well in the meaſuring of the ſtring, to the center of gravity, let the plummet be of what form it will.

But ſecondly, if I ſhould allow you a greater latitude in this experiment, as that you ſhould take bullets or plummets of ſeveral bigneſſes and weights, yea of ſeveral forms, yet the experiment will be much the ſame, and the number of ſwings will be equal in the equal time, if the length of the ſtrings be equal. * Only in this caſe, you muſt not meaſure the bare length of the ſtring, but meaſure from the center of gravity of the bullet or plummet, to the place where the ſtring is faſtened above: and thus doing, though a round bullet may ſeem beſt, yet any form of the plummet will do the like. And this rule muſt be obſerved alſo in the hanging of bells in Churches, that though the bells are of different ſizes and weights, yet they muſt all ſo hang, that there may be the like ſpace from the Axle-tree pin, or center of the motion, to the center of gravity of the bell; elſe the bells will never keep time: and the neerer they are thus hung, of equal length, in reſpect of their center of gravity, the better they will keep time, and ring the truer with leſſe trouble. This you may try likewiſe, as before with two different plummets, and you will find the number of ſwings equal, yea, though ye do not lift them up to the ſame angle

gle from the perpendicular, but the one to 30 or 40 degrees, the other to 60 or 70 degrees.

Thirdly, here is nothing therefore neceſſary to this purpoſe, which you need be curious about, but onely to know how long the ſtring muſt be, from the center of gravity of the bullet or plummet, to the point where the line is fixed, that ſo it may make a certain and deſired number of ſwings in a certain and determined time, *viz.* in a minute, or half a minute, or the hundred part of an hour. And to this purpoſe I have found, that if the ſtring (as aforeſaid, reckoning to the center of the plummet) be 38 inches and an half, then the plummet will make 60 ſwings in a minute of an hour, reckoning the ſwings both forward and backward into the number. And of this alſo your may as eaſily make trial your ſelf, either for this, or any other length of time, which you deſire.

3ly. All the care is to be had in the length of the ſtring, which is ſoon found, and is alwayes conſtant.

Fourthly, likewiſe if you deſire to have more or fewer ſwings in this time, or any other like parcel of time, you may finde it out by lengthening or ſhortening the ſtring, obſerving this rule (which you will quickly finde) that if you lengthen the ſtring, the number of ſwings will be fewer; but if you ſhorten the ſtring, the number of ſwings will be more.

4ly. You may ſo order the length of the ſtring, either by obſervation or calculation, to make any number of ſwings in any time deſired.

And herein that I may not leave you to run at randome, when there is a good rule to go by, which alſo proves the concluſion to be more conſiderable and Mathematical, you may take notice, that the number of ſwings have a *Quadratical* proportion to the length of the ſtring: reckoning, as I ſaid before, the ſhorter the ſtring, the more the ſwings; and the longer the ſtring, the fewer the ſwings; and therefore you muſt work by the back rule of proportion to finde out the length of the ſtring.

For example.

If 38 inches and an half make 60 ſwings in a minute of an hour,

hour, how many will 77 inches (which is double this length) make in the same time?

Inches 38.5. Swing 60. Square 60 — 3600

Inches 77.0. Swings 42.4. Square 1800

Here if you square the 60 swings, they make 3600, by which multiply the first number, 38.5 inches, the product makes 1386000. then divide this product by the third number 77.0, and the quotient is 1800. Lastly, finde the square root of this 1800, and it is 42.4. which shevvs if the string be 77 inches, the plummet vvill make 42 svvings, and almost an half.

And thus you may it finde, if you try by the string.

Again, if you vvould proportion the number of svvings to any time; as if you vvould have the plummet make 120 svvings in a minute of an hour, the manner of vvork vvill be the same, as in this example.

60 Svvings. 38.5 Inches. 120 Svvings. 9.625 Inches

Squ. 60	3600.	Squ. 120	
3600	231000	2400	
	1175	120	1386000(9.625
	1386000	14400	14400

Here if you square the 60 svvings, they produce 3600, vvhich multiplyed by 38.5. inches, make 1386000, as before; then square the 120 svvings, and they make 14400, by vvhich divide the former product, and the quotient vvill be 9 inches, and 625 thousand parts of an inch.

If you have a minde to alter this conclusion to any other number of svvings in a minute, you may see by this hovv to do

do it. If you vvould knovv hovv many of theſe ſvvings go to any other part of time, it is more eaſie being done by the rule of plain proportion, Thus according to the firſt length,

If one minute or 60 ſeconds	hath 60 Svvings	Then 36 ſeconds or the 100 part of an hour	hath 36 Svvings.

But I think there vvill be no need to do this, bnt you may be content vvith the firſt propounded length and time, vvhich is 35 inches and an half, making 60 ſvvings in a minute of an hour, vvhich anſvvers very vvell to the 60 ſeconds vvhich are in a minute, of vvhich there are 3600 in an hour, This length of the ſtring is very convenient, and the plummet will ſwing a longer time, then if the line be ſhorter, and it will require a good handſome weight of a pound, or half a pound at leaſt, which will not be ſo ſubject to be hindred by the wind as a leſſer may. Yet for a curious trial of a ſmall time, you may make uſe of the ſhorter length, 9 inches, 625 thouſand parts, this paſſing by the perpendicular line, 120 in a minute, makes a diſtinction not onely of the ſeconds, but of the thirds alſo, there being two ſwings to each ſecond, and this in a cloſe place, fitted with an handſome bullet, and a gentle ſilk ſtring, will ſwing a good while. And if you finde the motion begin to fail, you ma y help it with a gentle touch of your hand, and ſo make it ſtronger again. So I leave you to your own choice.

An Objection in reſpect of the unſteadineſſe of the Ship.

There is onely one thing that may be objected as doubtfull in the Practice of this concluſion: and that is leaſt the ſhaking and rouling of the ſhip, ſhould hinder the motion of the Plummet. And indeed ſuch is the nature of this motion, that nothing diſturbes it more then an unconſtant or diſorderly ſhaking thereof; As you may ſee by this eaſie proof.

The inconvenience not onely granted but proved by a Trial.

Take two ſtrings of equal length and plummets of equal length and weight, let them be both 38 inches ½, or any other

other length you pleaſe, let the one of them be made faſt to the top of a roome, and hold the other in your hand, holding your hand as ſteady as you can; let theſe two Plummets begin to ſwing both at one time, mounted to the ſame angle; yet that which you hold in your hand will goe ſomewhat ſlower then that which is fixed; becauſe you cannot (or very hardly) hold your hand ſo ſtill, but that the motion of your hand will alter the ſwinging of the plummet very ſenſibly, ſo that it will neither ſwing ſo faſt, nor ſo long, as that which is fixed. Yea, the more you move your hand: thinking to make it goe the faſter, it will goe ſo much the ſlower; and if you move your hand too faſt, thinking to force it beyond its owne natural motion; it will not ſwing at all.

How to prevent this inconvenience with a plain proof and tryal thereof.

But to prevent this inconvenience, I ſhall ſhew you how to order this concluſion another way, ſo that you ſhall not need to fix your line to any part of the ſhip, but hold it in your hand; and thus if the Sea be not too much overgrown, but that you may ſtand handſomely upright in your ſhip, you may by the ſwinging of the plummet find theſe ſmall moments of time as exactly as in a calm, or in a houſe upon the land.

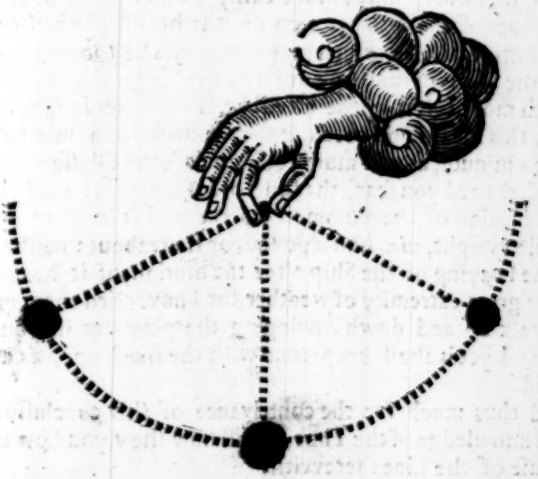
And to this purpoſe, becauſe the plummet held in the hand is ſubject to ſwing ſlower then the other, therefore the line muſt be ſomewhat the ſhorter, which by tryal I find muſt be* 31 Inches and an halfe.

*The length of a Minute line for 60 ſwings in a minute is 31 inches and an halfe.

Thus you may eaſily try your ſelfe, For take one plummet with a ſtring of 38 inches $\frac{1}{2}$, and fix it to the top of a Room; and take another plummet and make the ſtring thereof 31 inches $\frac{1}{2}$, meaſuring from the Center of gravity of the Plummet, and tying a knot at the end of the length, (which may be as a mark to know where to hold it, alſo help you in the holding thereof) hold this ſtring by this knot between the ends of your thumb and and fore-finger making it ſwing as faſt as handſomely you can, without

out diſturbing of the motion, either by too *much or too faſt moving of your hand, only with a gentle motion of your hand make the plummet mount alwayes as neer as you can to the ſame height, ſo that it may make an angle of 50 or 60 degrees with the perpendicular; and thus doing you ſhall find theſe two plummets (though the ſtrings differ thus much) to make an equal number of ſwings in the like ſpace of time; ſo that you cannot well make this in your hand ſwing faſter nor ſlower then that which is fixed, but either of them will make juſt 60 ſwings in a minute of an hour.

*You muſt not ſwing your arme too and fro, onely with a gentle moving of your hand make the plummet alwayes as neer it as you can ſwing to the ſame height.



In like manner, whereas the ſhorter fixed ſtring was ordered before to be 9 inches 625 parts, making it 8 inches and long, and tying a knot at the end thereof; If you hold this neatly between the end of your thumb and fore-finger, and make it ſwing ſo that it may mount at each ſwing to about an angle of 50 or 60 degrees, you ſhall find they will both

The length of a Minute line for 120 ſwings in a minute is 8 inches and a quarter.

both alike make 120 ſwings in a minute of an hour; and ſo ſhew you not onely the ſeconds but every halfe ſecond of time very exactly.

The concluſion of this experiment, ſhewing the beſt way for the practice hereof.

Thus this experiment will be moſt eaſie and ready upon all occaſions, So that this will be the very beſt way for the Sea-mans practice, for having thus once fitted his Minute line (as I may call it) and made a knot at the end thereof, as a conſtant marke where to hold it; he may carry it to any place of the ſhip where he hath occaſion to make obſervation of the Ships way, and hold it in his hand as well as his glaſs. And hereby alſo having his ſenſe of feeling, as well as his ſight, he may much more eaſily and certainly count the number of the ſwings, according as by occaſion they ſhall be more or leſſe, which may ſometimes be 100 or 200, vvhile the line is in running out; and the longer the time is, ſo much more certainty there vvill be of the obſervation, ſo that by this means you need not ſtint your ſelf to a minute, or half a minute, as you muſt do, if you uſe the Glaſſe.

Neither need you fear, that any ordinary winde vvill alter the motion of the plummet, eſpecially if it be of a conſiderable vveight, *viz.* half a pound, or thereabout: neither vvill the ſwaying of the Ship alter the motion, if it be not in ſome great extremity of weather, for I have tried that you may walk up and down, ſwinging the plummet in your hand, and yet it ſhall keep time with the fixed one, as aforeſaid.

And thus much for the contrivance of this concluſion for the knowledge of the Time, I ſhall now ſhew you how to make uſe of the Line therevvith.

How to make uſe of this concluſion with the ordinary Log-line.

In the firſt place, you may remember that I ſhewed you before to make knots upon your Log-line, at every 30 or 50 feet, and ſo many of thoſe knots as run out in a half a minute, ſo many 100 parts, or ſo many 60 parts of a degree your ſhip runs in an hour. Now here you ſee that 30

ſvvings

ſwings of the longer plummet, or 60 ſwings of the ſhorter plummet, are half a minute, vvhich I preſume you vvill find more exact and conſtant, then moſt glaſſes are or can be, and ſo you may make uſe of this concluſion inſtead of a glaſſe, yea, you may make, or try your glaſſe hereby, whether it be true or not.

How to make uſe of this concluſion, with the ordinary marks upon the Ships ſide.

But ſecondly, by this vvay you have not onely knowledge of the juſt period of each minute or half minute, but of every ſecond, or half ſecond, vvhich you may thus farther improve. For if you have a minde to ſet marks on your Ship ſides, as I ſhewed before four ſeveral wayes; all of which depend upon the knowledge of ſeconds of time, which a glaſſe cannot ſhew you, theſe ſwings being not only to every ſecond, but (if you uſe the ſhorter ſtring) to every half ſecond, will ſhew thoſe ſmall moments of time ſo exactly, that hereby you may come to a far greater certainty of your ſhips way, then if you ſhould meaſure the time, either by words, numbers, ſteps, or pulſes, or any other way formerly thought of.

A new way of ordering the Log-line.

But thirdly and laſtly, if you vvill keep a good account of your ſhips way, it will be needful to order your line ſo, that you may alwayes let as much line run out, as you can with conveniency of drawing it in again vvithout fear of breaking. Now the faſter your ſhip runs, ſo much the more line vvill you veer out at one time then at another, and alſo ſo much the more danger there is of breaking your line (vvhen it runs out too far and too faſt.) Therefore it will be the beſt vvay, not to ſtint your ſelf to a certain ſpace of time; (as you muſt do if you uſe the glaſſe) but rather to make your line of a good convenient length, and let the line alwayes run out this full length, and there ſtop, and ſo obſerve the minutes and ſeconds of the time, which the line is running out, or (vvhich is all one) the number of theſe ſwings of the plummets.

Now to this purpoſe, if you have a minde to reckon

To know the Ships way in miles or minutes of a degree.

your Ships vvay in miles, or 60 parts of a degree, each mile hath 6000 feet (accordiug to Mr. *Norwoods* Experiment and direction) now the tenth part of this is 600 feet, or 100 fathoms. This may be a very fit length for your line. If this length run out in six minutes, then the ship runs one mile an hour. If this length run out in three minutes, it is two miles an hour: if in two minutes, it is three miles an hour. For,

As $\begin{cases} 6 \text{ min. to } 60 \text{ min.} \\ 3 \text{ min. to } 60 \text{ min.} \\ 2 \text{ min. to } 60 \text{ min.} \end{cases}$ So $\begin{cases} \frac{1}{10} \\ \frac{1}{10} \\ \frac{1}{10} \end{cases}$ to $\begin{cases} \frac{10}{10} \text{ or one mile.} \\ \frac{20}{10} \text{ or two miles,} \\ \frac{30}{10} \text{ or three miles} \end{cases}$

And so for any other number of minutes. But this will be much more exact, if you reckon the running of the line not by whole min. but by seconds or swings; for the ship will not alwayes run this length in just even minutes of time, neither will the hourly motion of the Ship fall out alwayes in equal miles, or min. of a degree, and these fractions will be more easily reduced, and your work somewhat more exactly performed, if you account the Ships way in miles, and hundred parts of a mile, rather then in miles and 60 parts.

Thus if the Ship run the length of your line, being 600 feet, in 48 seconds of time, or 48 swings of the longer plummet, it is 7 miles 50 parts, or 7 miles and an half hour. If it run these 600 feet in one minute, 20 seconds; or 80 swings: it is 4.50, *viz.* 4 miles and an half in an hour. For,

As $\begin{cases} 48'', \text{ to } 3600'' : \text{ So } 600 \text{ feet, or } \frac{1}{10} \text{ of a mile, to } 750. \\ 80'', \text{ to } 3600'' : \text{ So } 600 \text{ feet, or } \frac{1}{10} \text{ of a mile, to } 450. \end{cases}$

This work is very easie, you need but divide 3600, the seconds of one hour, by the seconds in which the line is veering out, and the quotient shews the ships vvay in miles and ten parts: and if you adde one place more, making your divident 3600, the quotient will shew you the miles and hundred parts.

A Table

A Table shewing the way which a Ship makes, according to the minutes and seconds of Time, in which the Log-line is in running out, either in minutes or 100 parts of a degree, according to the different length of the Log-line, either 60, or 360 feet.

Time	Ships way		Time	Ships way		Time	Ships way		Time	Ships way	
′ ″	miles	pts.	′ ″	miles	pts.	′ ″	miles	pts.	′ ″	miles	pts.
0 10	36	00	0 40	9	00	1 10	5	14	1 40	3	60
11	32	73	41	8	78	11	5	07	41	3	56
12	30	00	42	8	57	12	5	00	42	3	52
13	27	69	43	8	37	13	4	93	43	3	48
14	25	71	44	8	18	14	4	86	44	3	45
15	24	00	45	8	00	15	4	80	45	3	42
16	22	50	46	7	83	16	4	74	46	3	39
17	21	18	47	7	66	17	4	68	47	3	36
18	20	00	48	7	55	18	4	62	48	3	33
19	18	95	49	7	35	19	4	56	49	3	30
20	18	00	50	7	20	20	4	50	50	3	27
21	17	14	51	7	06	21	4	45	51	3	24
22	16	36	52	6	92	22	4	40	52	3	21
23	15	65	53	6	79	23	4	35	53	3	18
24	15	00	54	6	67	24	4	30	54	3	15
25	14	40	55	6	55	25	4	25	55	3	12
26	13	85	56	6	43	26	4	20	56	3	10
27	13	33	57	6	32	27	4	15	57	3	07
28	12	86	58	6	21	28	4	10	58	3	05
29	12	41	59	6	10	29	4	05	59	3	03
30	12	00	1 00	6	00	30	4	00	2 00	3	00
31	11	61	01	5	90	31	3	96	01	2	97
32	11	25	02	5	81	32	3	92	02	2	95
33	10	91	03	5	72	33	3	88	03	2	93
34	10	59	04	5	63	34	3	84	04	2	90
35	10	28	05	5	54	35	3	80	05	2	88
36	10	00	06	5	45	36	3	76	06	2	86
37	9	72	07	5	37	37	3	72	07	2	84
38	9	47	08	5	29	38	3	68	08	2	82
0 39	9	23	1 09	5	21	1 39	3	64	2 09	2	80

Note if the Log-line be 600 feet long, then the Table shews the minutes and parts of a Degree, each mile being 6000 feet, & 60 miles in one degree. But if the Line be 360 feet long, then the Table shews the hundred parts of a degree, and their lesser hundred parts.

Time	Ships way		Time	Ships way		Time	Ships way		Time	Ships way	
′ ″	miles	pts.	′ ″	miles	pts.	′ ″	miles	pts	′ ″	miles	pts.
2 10	2	77	2 50	2	12	40	1	50	6 00	1	00
11	2	75	52	2	09	03	1	48	06	0	98
12	2	73	54	2	07	06	1	46	12	0	96
13	2	71	56	2	05	09	1	45	18	0	95
14	2	69	58	2	02	12	1	43	24	0	93
15	2	67	3 00	2	00	15	1	41	30	0	92
16	2	65	02	1	98	18	1	40	36	0	90
17	2	63	04	1	96	21	1	38	42	0	89
18	2	61	06	1	94	24	1	36	48	0	88
19	2	59	08	1	92	27	1	34	54	0	87
20	2	57	10	1	90	30	1	33	7 00	0	86
21	2	55	12	1	88	33	1	31	12	0	83
22	2	53	14	1	86	36	1	30	24	0	81
23	2	51	16	1	84	39	1	28	36	0	79
24	2	50	18	1	82	42	1	27	48	0	77
25	2	48	20	1	80	45	1	26	8 00	0	75
26	2	46	22	1	78	48	1	25	12	0	73
27	2	45	24	1	76	51	1	23	24	0	71
28	2	43	26	1	74	54	1	22	36	0	70
29	2	41	28	1	72	57	1	21	48	0	68
30	2	40	30	1	70	5 00	1	20	9 00	0	67
32	2	37	33	1	68	06	1	18	12	0	65
34	2	34	36	1	67	12	1	16	24	0	64
36	2	32	39	1	65	18	1	14	36	0	63
38	2	29	42	1	63	24	1	12	48	0	61
40	2	25	45	1	60	30	1	10	10 00	0	60
42	2	23	48	1	58	36	1	08	10 30	0	57
44	2	20	51	1	56	42	1	06	11 00	0	54
46	2	17	54	1	54	48	1	04	11 30	0	52
2 48	2	14	3 57	1	52	54	1	02	12 00	0	50

But becauſe I would make things as plain and ready as I can, I have calculated this foregoing Table, ſhewing you the ſhips way, according to this length of your line, (*viz.* 600 feet, or the tenth part of a mile) for minutes and ſeconds, even to every ſecond, where there is any need. So that finding the number of ſeconds in which the Ship is running this length of your line in the Table, there you ſhall find the Ships way ready caſt up to your hand in miles and hundred parts for one hour. And having the way for one hour, you may by Multiplication or addition ſoon finde the way your ſhip makes in 4, 8, 12 hours, or a whole day, or any other time deſired.

This Table you will finde very needful to ſave you much labour, and to prevent miſtakes.

Once more if you will reckon your Ships way in hundred parts of a degree, then there being 3600 feet in one hundred part, the tenth part of this is 360. And ſo if you make your line 360 feet long, and obſerve how long the ſhip is in running this length, and work as before, making uſe of this Table, (which ſerves for both) ſo you ſhall finde the way the ſhip makes in hundred parts of degrees, and their hundred parts, which will be the moſt exact way of account, and very ready to be ſet off upon your Maps and Charts, being for the moſt part graduated in Decimals.

How to fit the Log-line after this new way to ſhew the 100 parts of a degree, and their parts.

And this is ſomewhat the better way alſo, becauſe your line need not be ſo long, as if you reckon in 60 parts or miles.

Laſt of all, If you have a deſire to make marks by your ſhip ſides. Then if you will reckon by an hundred parts of a degree, make your two marks 36 foot aſunder: Or if you will reckon in 60 parts of a degree, *viz.* miles, make your two marks 60 foot diſtant; and ſo you may reckon the Ships way by this following Table.

To perform the ſame by marks upon the Ships ſide.

A Table

A Table shewing the way which a ship makes, according to the Seconds of time, in which any little thing swims by her side, between two marks placed thereon, either in minutes, or 100 parts of a degree, according to the distance of the Marks, being either 60 or 36 feet asunder.

Time	Ships way		Time	Ships way		Time	Ships way.	
′ ″	mil.	pts.	′ ″	mil.	pts.	′ ″	miles	parts
0 30	72	00	10 30	3	42	23 00	1	56
1 00	36	00	11 00	3	27	24 00	1	50
1 30	24	00	11 30	3	12	25 00	1	44
2 00	18	00	12 00	3	00	26 00	1	38
2 30	14	40	12 30	2	88	27 00	1	33
3 00	12	00	13 00	2	77	28 00	1	29
3 30	10	28	13 30	2	67	29 00	1	24
4 00	09	00	14 00	2	57	30 00	1	20
4 30	08	00	14 30	2	48	31 00	1	16
5 00	07	20	15 00	2	40	32 00	1	13
5 30	06	55	15 30	2	33	33 00	1	09
6 00	06	00	16 00	2	25	34 00	1	06
6 30	05	54	16 30	2	18	35 00	1	03
7 00	05	14	17 00	2	12	36 00	1	00
7 30	04	80	17 30	2	06	40 00	0	90
8 00	04	50	18 00	2	00	45 00	0	80
8 30	04	25	19 00	1	89	51 00	0	70
9 00	04	00	20 00	1	80	60 00	0	60
9 30	03	80	21 00	1	71	72 00	0	50
10 00	03	60	22 00	1	64			

And becauſe theſe lines and diſtances are very ſhort, you will do beſt to obſerve the time by the ſhorter plummet of 9 iuches 625 parts, ſo you ſhall have two ſwings for every ſecond of time, which will make your obſervation ſo much the more exact.

And if this way be carefully obſerved, it will be as exact as any other, that hath been uſed hitherto. All that can be ſaid againſt it, is: Firſt, the ſhortneſſe of the diſtance. Secondly, dead water by the Ship ſides, which is cauſed by the motion of the Ship. The firſt of theſe, the ſhorneſſe of the diſtance, this is recompenced by the exact account of the time, which may be found by this experiment to the half part of a ſecond. As for the dead water by the Ship ſides: This the line is alſo ſubject to in ſome ſort, though not ſo much: as you may perceive by the eddy and ſtilneſſe of the water, a good way after a Boat or Ship, which you muſt be careful in ſome ſort to allow for, when you uſe the line.

Caution how to order the Line in time of obſervation.

And therefore, when I direct you to have your line 360, or 600 feet long, you muſt not underſtand this to be the length of your line to be reckoned from the very Log. But firſt you muſt take ſo much line, as may let your Log float a good way from the ſhip, that ſo it may be out of the eddy and dead water of the Ship; and here you muſt place your firſt knot or mark, which you muſt hold in your hand, and let it go when you begin to count your minutes or ſeconds, and from this knot you muſt account the ſaid number of feet you deſire.

Make ſome triall how to prevent the ſinking of your Lines.

There will be alſo another inconvenience, when your line is long, which ought to be taken care of, and that is that your line will be ſubject to ſink in the water, and ſo not to veer out ſtreight. For it having no ſteady hold at the Log, and you being careful not to over-hale the log, and ſo bring it after you, the line will be ſubject to ſink, and ſo to veer out too faſt.

To prevent this, you muſt be careful to keep your line as

dry as you can, or to uſe ſome means to make it ſwim upon the top of the water; which whither it may be done beſt by oiling, or tallowing, or tarring, I leave it to your experience: And it were not amiſſe, if you put little corks here and there upon the line, to make it ſwim, if they can be ſo ordered, that they may not hinder the running of it out.

And thus you have the beſt way in uſe for the finding of the Ships way, which I have improved the beſt wayes I can, ſo that I doubt not but you will find ſome of theſe things worthy your trial and practice, both in the ordering of your line, and in your obſervation of the time. But yet for all this, both of them will be ſo ſhort, that a ſmall errour in either of them will amount to much in an hour, and more in longer time.

The beſt comfort is, that you are not alwayes forced to truſt to this way of account. For when you make any conſiderable alteration of latitude in your courſe, you may by obſervation thereof correct your errours herein, and by obſerving how theſe rules agree with ſuch courſes, you will know the better how to judge of them, and to uſe them for the future.

The deſcription of ſeveral Engines, for the more conſtant and certain finding of a Ships way.

And yet becauſe this way of account is of very good uſe and much practice; and many times you may be forced to make uſe of it, not only in your courſes of Eaſt and Weſt, but ſometimes alſo in any other courſe; as when it is cloudy dark weather, ſo that you cannot ſee Sun or Stars ſo as to make a good obſervation thereby in many dayes. Therefore ſome have indeavoured to make this way of account more perfect, by deviſing ſome way of meaſuring the ſhips motion for a much longer time, ſo as it might ſerve not only for hours and dayes, but for an whole voyage.

To

To this purpose I finde in an ancient Book of Mr. *William Bourn*, entituled, *Inventions and Devices*, his 21 Device is to make an Engine to know the way or going of the Ship, which he thus describeth these words.

"There must be a little small Boat, and then there must
"be placed a wheel in the Boat, that the arms must go in the
"water, and so as the Ship passeth in the Sea, so the vvay of
"the ship doth turn the vvheel by the arms that goeth in
"the vvater; and from that vvheel or vvheels that goeth
"on the outside of the little Boat, there comes an Axletree,
"and upon that there is a note, vvith six or eight teeth more
"or lesse, as the Devisor or maker shall see good, and that
"Note shall turn another vvheel by the teeth on the cir-
"cumference: so that vvhen the vvheel on the outside of
"the little Boat hath gone 50 or 100 times about, that the
"Note on the Axletree shall turn the inner wheel but once
"about: And then the thing being tried, that vvhen the
"vvheel vvith armes that goeth in the vvater hath gone
"once about, that the ship hath gone so many feet or in-
"ches, and then the wheel on the out-side having gone
"such a number of times about, as to have turned the next
"vvheel, the ship must needs go 50 or 100 times so much
"more, & then that vvheel shall have a Nut upon the Axle-
"tree thereof, and turn another vvheel; and so you may
"make one vvheel upon another, that the last vvheel shall
"not be turned about, until the ship hath gone 500 or 1000
"leagues: As for example. The wheel that goeth on the
"out-side of the little Boat, when that it is turned round a-
"bout once, the ship hath gone just six foot, that is, one fa-
"thom, and now the Note that goeth on the Axletree, doth
"turn the next in such sort, that when the outward wheel
"hath turned 100 times about, this is turned once, and
"then the ship hath gone 600 feet, or 100 fathoms. And if
"this wheel turn another wheel in like order, that is for 500
"turnings to turn the other but once: then when this wheel

I
Mr. *Bournes* Engine.

" hath turned about, you may conclude that the ſhip hath
" gone 100 times 100 fathomes, that is 10000 fathoms,
" which is four leagues. And this wheel may turn another
" in the ſame order; and when this wheel is turned about,
" the ſhip hath gone 100 times 4 leagues, that is, 400
" leagues. And to ſee and know how theſe wheels do turn,
" there muſt be certain ſpurs, ſuch as the hands, or pointers
" of clocks to come from the wheels, &c. And this Inſtru-
" ment being towed in a little cloſe Boat, will ſhew you the
" way of any ſhip, that is to ſay, how faſt or ſlow the ſhip
" goeth through the water. The Deviſer of this Engine or
" Inſtrument, ſaith he, was *Humphrey Cole*.

This I have quoted, not that I would have you to put it in practice, for I confeſſe the Invention is very rude, and ill contrived; for which cauſe I believe it hath ſeldome been uſed by any. But rather as an Apology for what I have had ſome thoughts upon to this purpoſe, that ſo I might not be thought too ſingular therein. For though I had ſome thoughts of theſe things long before I ſaw this Book, yet this made me the bolder to publiſh them, becauſe I found hereby that I was not the firſt that had ſuch conceits, but that they had been entertained by ancient Sea-men formerly.

This invention may be much bettered in theſe things:

Certain obſervations and corrections of this Engine.

Firſt, whereas he preſcribes the Water-wheel to be on the outſide of the Boat, if the Boat have but one wheel on the one ſide, it will make the Boat go all awry, and ſo hinder the motion of the wheel. If it have two vvheels, it will be a thing needleſſe, and make the Engine which ought to be as ſmall as may be, more unweildy. Beſides, if theſe vvheels either one or tvvo lie open on the outſide of the Boat, then if the Sea be not very calm, the water will many times run over the Axle-trees of the wheels, and ſo hinder the motion thereof; or elſe they muſt go very ſhallow in the water. To remedy all theſe inconveniences, it is better to have only one vvheel, and this to come out juſt in the middle of the bottom

bottom or ſtern of the Boat or Engine, to a certain quantity; & ſo the Boat to be cloſe on the top and ſides, that no water may touch any part of the vvheel, but that which hangs out under the Boat.

In the ſecond place he doth very inartificial preſcribe the proportion between the Nuts and the wheels, making the one to the other, as 50 or 100 fold; and yet he would have the Nut to have 6 or 8 teeth, ſo that the vvheel that follows muſt have 300 or 400 teeth, for the 50 times; and 600 or 800 teeth, for the 100 fold proportion: either theſe teeth therefore muſt be very fine and ſmall, as the teeth, of little clocks or watches: or the wheels muſt be very great, and ſo not fit for ſuch a little Engine. But this may be eaſily helped, by making a vvheel or tvvo more, ſo that the vvheel and nut may have at moſt but a ten-fold proportion.

For example, let the compaſſe of the vvater-wheel be 10 foot, or 120 inches, the diameter will be 38 inches, 18 parts, the ſemidiameter 19 inches, 9 parts, 2 third parts of this, or about 12 inches deep may lie in the water out at the bottome of the Boat or Engine: So this vvheel vvill turn about every ten feet the Ship runs. This vvheel may turn the ſecond vvheel once about in ſix times, which will be in 60 foot motion. This may turn the third vvheel about once in ten times, which will be in 600 feet motion. This may turn the fourth wheel about once in 6000 feet motiō, which is one mile. This may turn the fifth vvheel, or rather an hand or Index once in ten miles. Or if you will, you may make a ſixth vvheel to turn about once in 60 or 100 miles. And theſe five wheels may be contrived in a leſſer compaſſe, then two or three ſuch great ones as he preſcribes and all of them ſhall ſcarce have half the number of the teeth of one of his wheels: for theſe three wheels need have but 60 teeth apiece, which is 180: yea, the firſt needs but 36 teeth, whereas a wheel that muſt be turned about 100 times with a nut of ſix teeth, muſt have 600 teeth.

This Engine may well have the wheel 10 foot compaſſe, for ſo the diameter will be but about a yard over, which will be no great cumber, eſpecially in a great ſhip: Yet if you will you may make the wheel but ſix foot about, ſo the diameter will be but 2 feet; burthen the Water-wheel muſt turn the next wheel 10 times about to make 60 feet of the ſhips motion.

Thirdly,

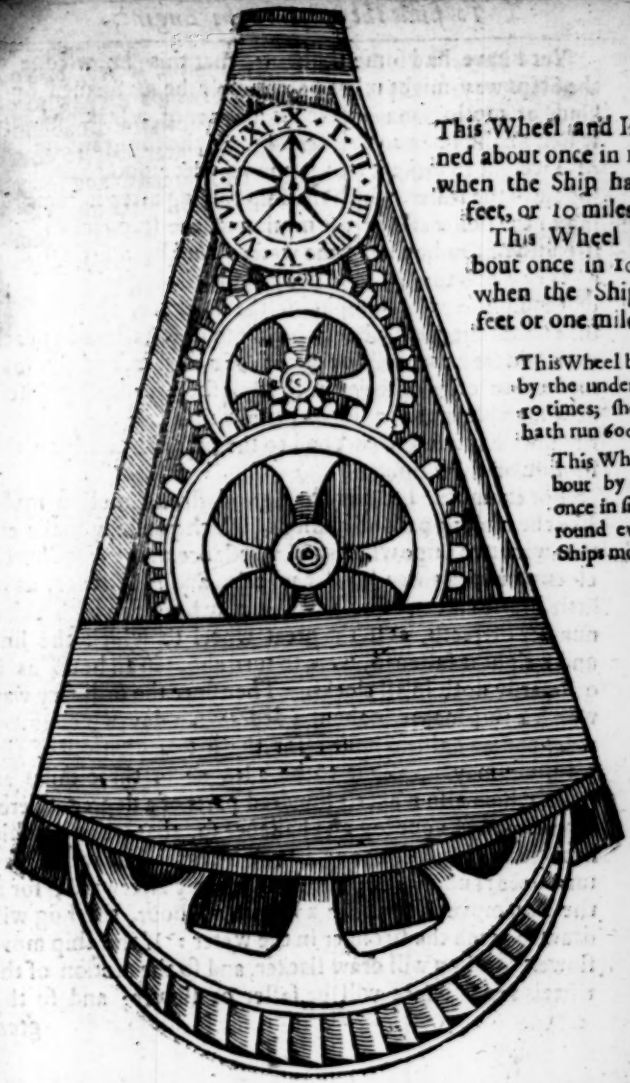
A second Engine for this purpose.

Thirdly, as for the form of this Engine, it will be too cumberſome to make it in a cloſe Boat which may ſwim of it ſelf, and to be towed after the ſhip, for ſo the Boat muſt be made to ſwim two foot above the water, for to cover the upper part of the vvheels, and ſo the breadth and length muſt be in ſome ſort proportionable. But it were much better to have this made in the form of your Flemiſh * Sideboards, being hollow at the bottome for the water-wheel to move in, and ſo the other wheels to be within it alſo one above another, and their ſpindles coming out may have hands or pointers faſtened to them, which may ſhew the miles, and leagues, and degrees of the Ships motion. And this may be faſtened to the Ship ſides, as theſe Dutch Sideboards, and ſo drawn up or ſet down into the water, as you have occaſion to uſe them: or it might be ſo contrived, that it might have a little cloſe Boat croſſe the lower part of the water-vvheel, that it might partly hang, and partly ſwim, and ſo it vvould play up and down in the water, as the water doth by the Ship ſides.

And thus hanging you need but look out a little upon the ſpindles or hands, and ſee how far your ſhip hath gone at any time. And thus with ſome fevv alterations or additions, as you ſhall ſee cauſe, this Engine may be made uſeful; vvhich muſt needs tell you the motion of your ſhip very neer, and being either thus, or after your ovvn fancy handſomely contrived, may be uſed at moſt times, and if you vvill, moſt part of your Voyage, if the Winde and Waters be not too tempeſtuous.

* The Flemings have an Oval-board hanging on each ſide of their Ships, which they let down in the water as they ſee occaſion, which makes me ſuppoſe that this Engine may very well be made much after the ſame form, and uſed in the ſame manner; only it muſt be a little thicker toward the lower end, that ſo the water-wheel may turn within it, for the better ſhelter; and that the motion thereof may not be hindred, by the daſhing of the waves ſometimes on the upper part thereof.

Yet



This Wheel and Index being turned about once in 10 times, ſhews when the Ship hath run 600000 feet, or 10 miles.

This Wheel being turned about once in 10 times, ſhews when the Ship hath run 600 feet or one mile.

This Wheel being turned about by the under Wheel, once in 10 times; ſhews when the Ship hath run 600 feet.

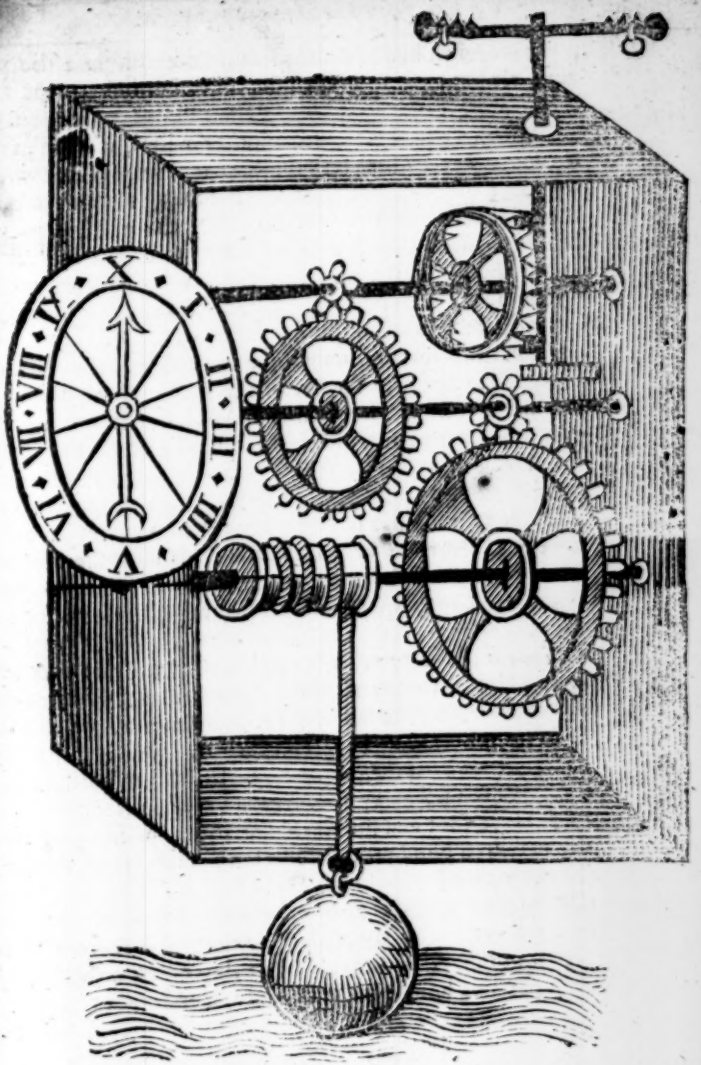
This Wheel being turned about by the Water-wheel, once in ſix times; will turn round every 60 feet of the Ships motion.

This water-wheel being about three foot two inches over, will be ten foot compaſs, and ſo will turn about at every ten feet of the Ships motion.

A third Engine, being a Water-Jack.

Yet I have had ſome thoughts, that this knowledge of the Ships way might more handſomely be performed by a kinde of motion, made after the manner of a Jack or Clock which might be ſet in the ſteeridge of the ſhip, and inſtead of a weight to make it move, you may let a good handſome log lie in the water, which the ſhip towing after it, according to the ſwiftneſſe of the motion of the ſhip, ſo will the ſtrength of the Log be in the water. And by a little trial it will be an eaſie matter ſo to proportion the bigneſſe or ſhape of the Log, and the weight of the ballance, that it ſhall turn about the great wheel whereunto it is faſtened at each each hundred part, mile or minute of a degree, and this may turn about other wheels which ſhall ſhew by little pointers how many leagues or degrees the Ship hath gone at any time, without any reſpect had to the time, but onely to the motion of the Ship.

For example. Let there be a good ſtrong motion made like the moving part of a Clock, which you may make either with two large wheels and a ballance, as in great Church clocks, or with three ſmaller wheels, and a ballance, as in little braſſe clocks. Theſe wheels may be made with ſuch a number of teeth, as if the great wheel to which the line and weight is faſtened, were to turn about in an hour, as it ordinarily doth in all clocks. Then ſince the ordinary way which a ſhip makes, is about a degree in a day, which is two miles and an half an hour; for the better diviſion of the way, we may ſuppoſe it to be a league or three miles an hour, which alſo makes 5 hundred parts of a degree. Therefore if you fit your log and ballance ſo, that when the ſhip hath gone a league or 500 parts of a degree, this wheel may turn once round; it will do ſo conſtantly afterward; for if the ſhip move faſter then a league an hour, the Log will draw ſo much the ſtronger in the water: If the ſhip move ſlower, the Log will draw ſlacker, and ſo the motion of the wheels and ballance will be faſter or ſlower; and ſo this great


X
I
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great wheel will ſtill be turned about every league the ſhip runs, without any reſpect to the time, but only to the pace the ſhip moves.

Now this wheel may turn another whsel, which ſhall as the hour-wheel of a clock turn about every ten or twenty leagues; and theſe wheels having hands or pointers upon their ſpindles; the one may ſhew the number of leagues or hundred parts, and the other the parts of the leagues or hundred parts, as they are in motion. And this being wound up every ten or twelve leagues, may be kept conſtantly going and ſo ſhew the ſhips way all the whole Voyage.

If you think this motion will be too dull and ſlow to ſhew a league at every Revolution of the great wheel, then you may make it ſhew but one mile an hour, or but one hundred part of a degree, it will onely require ſo much the oftner winding up. And this will be better then to increaſe the number of the teeth of the wheels, for ſo the motion vvill be made to go ſo hard, that vvhen the ſhip moves any thing ſlowly, the motion vvill ſtand ſtill. It muſt therefore be made vvith a light ballance, and reaſonable ſmall numbers, that ſo it may go quick and gentle, with a little vveight or force.

Thus if the great vvheel vvhich is to turn about once every 100 part ſailing, turn the ſecond vvheel ſix times about, and this turn the ballance vvheel ſix times about, and the ballance vvheel hath 15 teeth, each tooth giving the ballance two ſvvings, the one one way, the other another vvay, the ballance vvill make 1080 ſvvings, vvhich is a ſvving for every three foot and four inches of the ſhips motion. And this may be a good proportion, both in reſpect of the ſhips ſlovver and faſter motion. For thus if the ſhip go but one or tvvo hundred parts an hour, the ballance vvill make 1000 or 2000 ſvvings in that ſpace, vvhich vvill be enough to keep it going. And yet again if the ſhip go ſix or eight hundred parts an hour, yet the ballance, if it be not too heavy,

but

but hang and play vvell, may make ſix or eight thou and ſwings in that time very vvell, for the ballance of a pocket vvatch makes 18000 ſvvings in an hour.

And thus the Index-vvheel, turning about once in ten times of this vvheel, vvill ſhevv the tenth part of a degree, or a double league, and if you vvill, you may make another Index vvheel, to turn about once onely in a degree.

As for the form of the Log, vvhich muſt be inſtead of the vveight to move this motion: It vvere beſt to have it round, for if it ſhould be a Cone, or like a Sugar-loaf it vvould cut the water ſo eaſily, that it vvill not make ſtreſſe enough upon the vvheel to make the motion go. And if it be of any ſquare or angular form, it may make the ſtreſſe very unhandſome and unequal. It will be good alſo to make this Log of good cloſe wood, that ſo it may but juſt ſwim; for ſo it will hold the water the better, and not be ſubject to leap out of it, and alſo it will laſt the longer; for as it vvill be ſome trouble to fit this Log at the firſt, to a juſt proportion or bigneſſe, ſo it will be good to keep it at one ſtint, vvhen you have found the true quantity, and not to make it of vvood that vvill ſplint or rot preſenty.

But now in the laſt place, the fitting of this Log and the ballance vvill be the chief buſineſſe, which requires your care. And to this purpoſe the beſt way will be, not to alter your Log, by making it leſſe or bigger, vvhich may be gueſſed at reaſonable vvell by any ingenious Work-man, that ſhall take upon him to make them, for it muſt be according to the ſtrength of the wheels and vvork. But the beſt way to equalize the motion, vvill be to have your ballance poiſed with little moveable weights, as ſmall bullets hanging in vvyer, or ſuch like, and to have notches in the croſs rod of the ballance, at equal diſtance from the center thereof. Novv the farther off from the center of the ballance that you place theſe little vveights, ſo much the ſlovver vvill the motion be: and the neerer to the center that you ſet them, ſo

much the ſwifter vvill the motion be. Therefore vvhen you are neer the land, and ſo can ſee by-marks and places, and ſo knovv the diſtance: or rather vvhen you run a fair courſe at Sea neer the Meridian, and ſo know by your difference of latitude your vvay exactly, then take ſome care to equalize your motion, placing the plummets neerer to the center, if the motion goeth too ſlow, and farther from the center, if the motion goeth too faſt; alwayes remembring to place both of them equally diſtant from the center. And having thus equalized your motion to the Ships way, it muſt needs alwayes accord therewith, provided you keep it clean and neat from ruſt and duſt, by making it clean now and then, and making ſome caſe for it to ſtand it.

A fourth ſort of Engine, by the winde.

There might alſo be a fourth ſort of Engine contrived for this purpoſe, which ſhould ſhew you the motion of the ſhip according to the force of the winde. And that this may ſeem the more reaſonable, conſider that the winde is that, which chiefly, if not onely, cauſeth the ſhip to move in the water. For though the ſhip be ſometimes moved with the Tides, Streams; or Currents of Rivers, yet this cannot be obſerved any of the former wayes, though you muſt have a great care, to obſerve thoſe, as you may ſee in the former part of this Book, and in the ſixth Chapter, Sect. 5. of my *Geometrical Sea-man*. But this motion which we now obſerve is onely cauſed by the force of the winde. Therefore if there were a little Engine made in the form of a Wind-mil, this placed conveniently at the ſtern of the ſhip, the ſayles would be turned about by the winde faſter or ſlower, as the winde did blow more or leſſe, and theſe little ſayles might turn about two or three other little wheels within them, which by ſome trial might be ſo compoſed with fit numbers of teeth, that they might ſhew when the ſhip had gone a mile or two, or a league or more, as the wheels in the former Engine, which was turned by the water.

For example. Let the Sayls be about two foot diameter, the

the compaſſe of the circle will be about 6 foot: Now ſuppoſe theſe ſayles be ballanced, ſo that they may turn about every ſix foot of the ſhips motion, then if theſe ſayles turn another wheel every ten bouts, and this another every ten bouts of that, and this wheel ſhall turn another every ten bouts of that, this third wheel will turn about once in 6000 feet, or one miles motion. And ſo you may multiply wheels and order them as you pleaſe.

Sayles 6.
1 wheel 60.
2 wheel 600
3 wheel 6000.

But now in this Concluſion, there will be theſe things conſiderable:

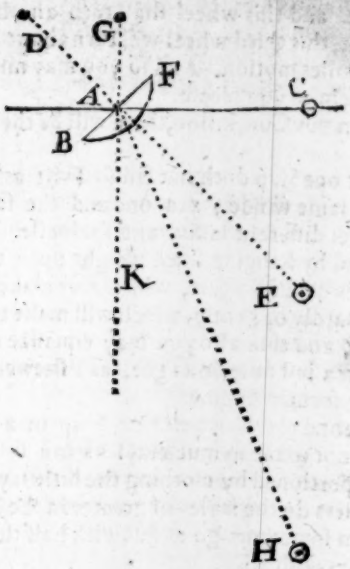
Firſt, that one Ship doth not ſail ſo ſwift as another with one and the ſame winde; yea, one and the ſame ſhip, according to her different lading and foulneſſe. This may be counterpoiſed by hanging ſome weight upon the Axle-tree of the Sayles of the Engine, which may make them move a little more hardly or gently, which will make them go ſwifter or ſlower, and thus alſo you may equalize the motion of the wheels to a juſt mile or league, as I ſhewed for the ballance of the former Engine.

In the ſecond place, whereas a Ship in a ſtiffe gale of winde need not to uſe ſo much ſayl as in a ſtiller gale; this may be proportioned by clothing the little ſayls of this Engine, as Millers do the ſayles of greater in the like occaſions, making them ſometimes go as faſt with half their clothes, as at other times with all.

Thirdly, whereas the ſhip doth not ſayl alwayes right before the winde, but ſometimes with a quarter or ſide-vvinde, and yet this Engine muſt be turned alwayes to the vvinde, and ſo vvill ſhew the way, as if the Ship vvent before the vvinde. This muſt be conſidered and allovved for by ſome vvay of calculation: as thus:

Suppoſe the vvay of a Ship lie Eaſt and Weſt, as A C, but the vvinde is North-vveſt, as D E: let the Ship be at B, and trim her ſayles before the vvinde, they vvill lye as B F, ſuppoſe the motion of the ſhip (as being before the vvinde)

to be B E, or South-east 10 miles: Yet the motion of the Ship, according to her course East and West, will be but A C, which is onely 7 miles East.



Sometimes the winde will be so much side-wayes, that they cannot trim their sayls to the widde, but are glad to trim them side-wayes to winde.

Thus, let the ships way be A C, East, as before, and the winde G C full North, and the sayls B F, as before, the ships way will be as it were A H, which is South-south-east almost 20 miles, before it can come to the place C, or East 7 miles. After some such way as this, the way of the ship might be found out according to any side-winde, knowing

knowing the way of the ship according to the full winde This I confesse is the most troublesome part of the businesse, otherwise this Engine would be of ready use and service for this purpose. However I doubt not, but with a little practice and observation, this as well as the other Engines may be of good use and profit to those who shall set upon the making or the using of them.

FINIS.

ERRATA in the first Part.

Page 27. line. 6. read right *lined* triangle, for right tr. pag. 21. lin. 22. r. makes 41000, *which divided by* 71. *makes* 5775, which, &c. p. 22. l. 2. r. 6724. f. 7624. p. 22. l. 10. r. 41. f. 71. p. 34. l. 18. r. Longitude, f. Latitude. p. 45. l. 20. r. from A to E. f. you p. 55. l. 7. r. 5. f. 3. p. 60. l. 1, & 2. r. SE. f. SW. p. 62. l. 2. r. 0 deg. f. 1 deg p. 66. l. ult. of the Table, r. 1752. f. 52. p. 86. l. 15. r. 40. f. 50. p. 91. l. 31. r. from L upon the line P B, and thereby finde the perp. &c. p. 108. l 13 r. 26. f. 23. p 118. l. 3 r. 56. f. 36. p. 125. l. 22. r. 7. 07. f. 15. p. 131. l. 10. r. North & South, *being either of them* 150 *Poles*, 35 *pts. and the East and west* being, &c.

ERRATA in the Canon.

	D	N	Correction.		D	N	Correction
Tanng.	86	74	1058.20	Secant	76	39	161.10
S. Diff.	06	48	0.09	Sine	43	08	05.85
Tang.	84	45	475.75	Sine	44	67	48.20

ERRATA in the second Part.

Page 2. l. 31. r. 6000. f. 600. p. 15. l. 8. r. 38. f. 35. p. 21. l. 4. r. 600. f. 60. p. 24. l. 3. 60000. f. 600000. and l. 7. 6000. f. 600.